Reports File
no action
[illegible]

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
PROJECT INITIATION

Date: June 26, 1974

Project Title: Crash Program to Provide Assistance to Business and Industry in Coping With the Energy Crisis

Project No.: A-1644

Project Director: Dr. John W. Tatom

Sponsor: Economic Development Administration, U.S. Department of Commerce

Effective June 10, 1974 Estimated to run until June 9, 1975

Type Agreement: Grant No. 99-6-09359 Amount: $ 134,970*

Reports Required: Quarterly Progress and Financial Reports; Draft Final and Technical Report; Final Technical Report.

Sponsor Contact Person (s):

Chief,
Program Development and Initiatives Division
Office of Technical Assistance
Economic Development Administration
Washington, D.C. 20230

*Plus EES Contribution of $44,990; Cost Sharing Account No. E-102-100

Assigned to TECHNOLOGY APPLICATIONS GROUP Division

COPIES TO:

- ☐ Project Director
- ☐ Director
- ☐ Assistant Director
- ☐ GTRI
- ☐ Division Chief (s)
- ☐ Branch Heads
- ☐ Service Groups
- ☐ Patent Coordinator
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- ☐ Project File
- ☐ Other

RA-73

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

no action

Date: August 5, 1977

Project Title: Crash Program to Provide Assistance to Business & Industry in Coping with the Energy Crisis

Project No: A-1644

Project Director: J. L. Birchfield

Sponsor: Economic Development Administration, US Dept. of Commerce

Effective Termination Date: 7/22/77

Clearance of Accounting Charges: 9/30/77

Grant/Contract Closeout Actions Remaining:

- [ ] Final Invoice and Closing Documents
- [x] Final Fiscal Report
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other ______

Assigned to: Technology & Development Laboratory (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
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Project File (OCA)
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Other ______

CA-4 (3/76)

File: A-1644

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 3, 1974

Mr. Louis J. Phillips
Chief, Program Development
and Initiatives Division
Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20220

Dear Mr. Phillips:

In accordance with the conditions of Grant Project No. 99-6-09359, "A Program to Assist Business and Industry in Coping with the Energy Crisis," we are submitting herewith our work schedule plans and suggested format for project reports.

Since the proposal was written, the character of the energy problem has changed from that of an acute crisis to a chronic long term shortage. Thus, for our study to be useful, we believe that an increased focus should be directed toward the long term problem. No changes in the types of work proposed are required, but to achieve this, it is anticipated that some changes in emphasis are needed. Also, because of the growing concern regarding the availability and utilization of materials, it is felt that a greater portion of the study should be directed toward this problem. These two ideas are therefore reflected in the objective and plan of the study presented in the following paragraphs.

The project has been divided into three phases: a Research Phase, an Implementation Phase, and a Review Phase. The work plan is shown in Figure 1 and the project schedule together with estimated manpower requirements are presented in Figure 2. The various tasks involved in the project as well as the task objectives are as follows:

I. Analysis of Data on Hand
Determine data needed, establish priorities, and consolidate list of known conservation aids.

II. Audit Planning
Design audit procedures and test on a selected group of firms.

III. Data Collection and On-Site Technical Assistance
Conduct the engineering audit, disseminate known conservation helps, and provide whatever on-site assistance we can.

IV. Data Analysis
Reduce data collected; analyze energy and material use within the plant and their economic impact.

V. Develop Alternatives
Identify and analyze alternatives for energy conservation including processing, scheduling, fuel, and material alternatives.

VI. Workshops and Seminars
To help industry implement energy conservation potentials identified during the course of the audit.

VII. Reporting
To keep industry and EDA informed of our progress and findings.

An Advisory Group has been formed as part of the Review Phase. This group consists of government and industry leaders in the State of Georgia who will meet periodically with project personnel to review and critique the work. The function of this group will be to advise us on the needs of business, industry, and government and to enhance the effectiveness of our work with these groups.

We recommend that the Quarterly Progress Reports be divided into three parts: the first part being a description of the work accomplished during the past quarter, the second part being a discussion of any particular difficulties or breakthroughs encountered and the third part being an estimate of the work to be accomplished during the next quarter. The format for this report is shown in Figure 3.

If there are any questions regarding this work plan and schedule, please feel free to contact the Project Director, Dr. John W. Tatom (telephone: 404 894-3415) or the Associate Project Director, Mr. C. H. Bonham (telephone: 404 894-3475). We look forward to the opportunity of working with you on this research project.

Sincerely yours,

John W. Tatom
Project Director

ct

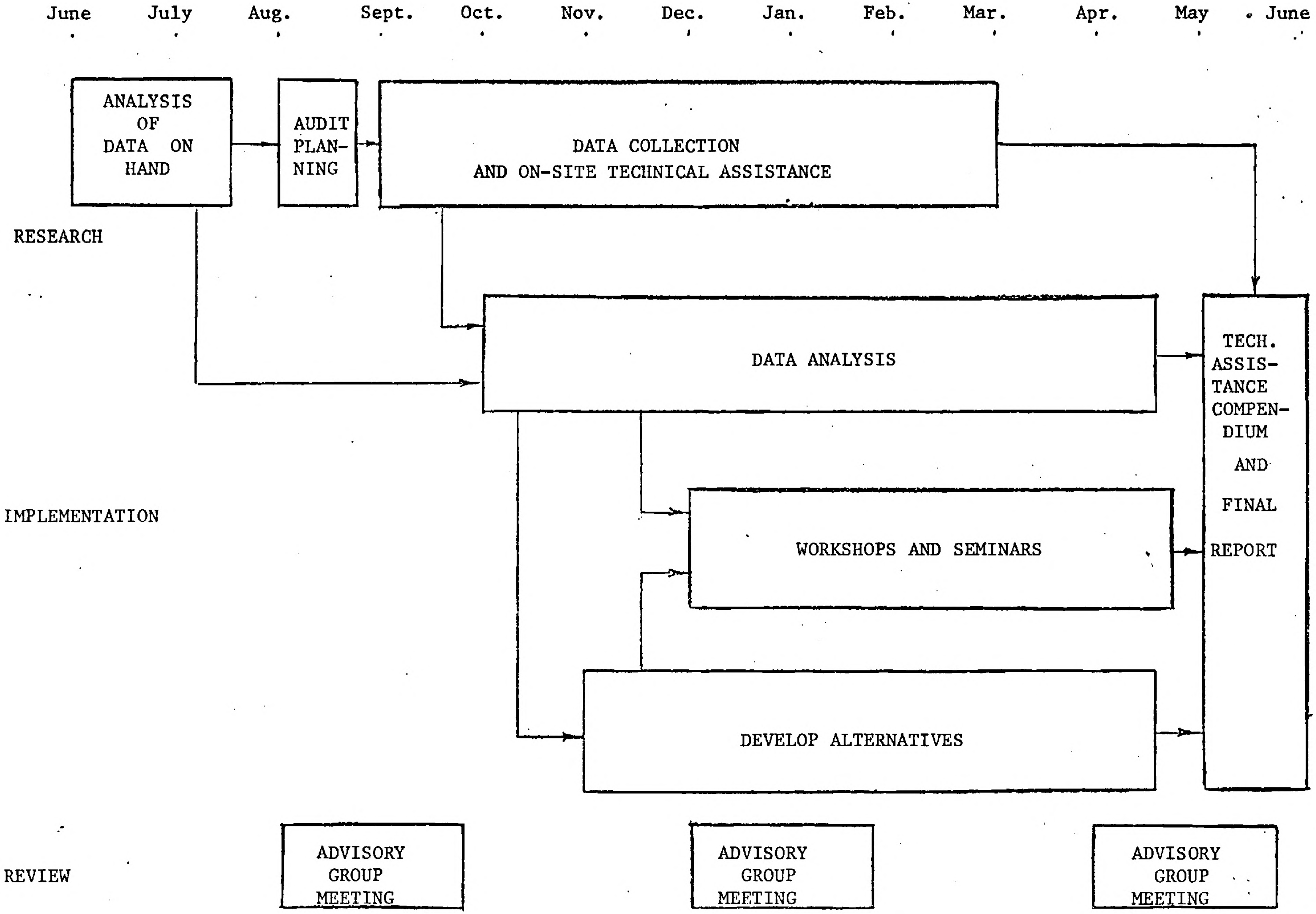


Figure 1. Program Work Plan

PROJECT SCHEDULE

Figure 2

TASK NUMBER	TASK DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	Man Months
I	Analysis of Data on Hand													3
II	Audit Planning													2
III	Data Collection													18
IV	Data Analysis													11
V	Develop Alternatives													8
VI	Workshops & Seminars													4
VII	Reporting	↑		* ↑			* ↑			↑		*	↑	5
													Total	51

(Column headings: MONTHS FROM CONTRACT AWARD, 0–12)

Legend: ↑ indicates report submission

* indicates meeting of Advisory Group

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 3, 1974

Mr. Louis J. Phillips
Chief, Program Development
and Initiatives Division
Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20220

Subject: Technical Assistance Project No. 99-6-09359 Quarterly Progress Report No. ____ for the period __________ through __________

Dear Mr. Phillips:

During the past quarter the following work was accomplished on the tasks shown below:

A.

No significant difficulties were encountered - The following problems were encountered during the past quarter. (Discuss the implications of these problems.)

It is anticipated that the following will be accomplished on each of the tasks during the coming quarter:

A.

Figure 3. Proposed Progress Report Format

ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

September 10, 1974

Mr. Louis J. Phillips
Chief, Program Development
and Initiatives Division
Department of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20220

Subject: Technical Assistance Project #99-6-09359, Quarterly Progress Report #1 for Period June 10, 1974 - September 9, 1974

Dear Mr. Phillips:

During the past quarter the following work was accomplished on the tasks shown below:

Task I: Analysis of Data on Hand - This task has been essentially completed. The analysis of the data collected during last year's in-house effort has been completed and the results were used as a basis for planning our engineering analysis. A priority list of industries to be visited was established using total energy consumed, employment, and value added as the selection criteria. It is anticipated that representative firms in the industries consuming 70 percent of the energy and accounting for 70 percent of the employment and value added in the State will be visited. Also, a check list of energy conservation aids has been compiled for distribution to the plants visited.

Task II: Engineering Analysis Planning - The procedures to be followed in conducting the in-plant analysis have been developed and initial contacts have been made with some of the trade associations to publicize the project. Also, contacts were made with the Maryland and Colorado programs to coordinate our efforts.

Task VII: Reporting - The first meeting of the Advisory Committee was held on September 5th. It was a very fruitful meeting; the participants endorsed our efforts to date and helped determine ways to solicit and encourage industry participation. One very useful suggestion was to split the industries into two categories--the larger ones such as paper and pulp mills who have already done their own conservation surveys and those smaller industries that have not. The approach to be taken with the first category is to solicit their results for inclusion in our report and then concentrate our efforts on the smaller industries that need the most help.

No significant difficulties were encountered.

It is anticipated that the following will be accomplished on the tasks during the coming quarter:

Task II: Engineering Analysis Planning - This task will be completed within the next few weeks, after testing the analysis procedures on a small group of firms.

Task III: Data Collection and On-Site Technical Assistance - This task will be initiated with visits being concentrated in the highest priority industries. It is anticipated that the top priority group visits will be completed and the second priority group visits initiated before the end of the quarter. The top priority group is the top ten industries by three digit SIC code and they represent about 50 percent of the energy consumption, 35 percent of the employment, and 40 percent of the value added by industry in Georgia.

Task IV: Data Analysis - Analysis of the data collected from the top priority industries will be initiated.

Task V: Develop Alternatives - The results of the plant visits and the analysis of that data will be used to develop alternatives and potentials for energy conservation in each industry visited.

Respectfully submitted,

John W. Tatom
Principal Research Engineer

JWT/edh

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

December 10, 1974

Mr. Alfred E. Diamond
Economic Development Administration
United States Department of Commerce
Washington, D. C. 20230

Subject: Technical Assistance Project #99-6-09359, Quarterly Progress Report #2 for Period of September 10, 1974 - December 9, 1974

Dear Al:

During the past quarter the following work was accomplished on the tasks shown below:

Task I: Analysis of Data On Hand -- This task has been completed. The consolidated list of energy conservation aids was completed and manufacturers data on boilers, driers, air conditioners, etc. was compiled and reviewed. Engineering analysis data forms were designed for use in determining efficiency of energy use during in-plant visits. (Copies are attached.)

Task II: Engineering Analysis Planning -- The procedures to be followed during the data collection and on-site technical assistance phase were developed. The procedures were tested and evaluated during visits to two local firms. Some modifications to the procedures were made and after some further testing they were formalized. Copies of the team procedures and data and report forms are enclosed. Task II has been completed.

Task III: Data Collection and On-Site Technical Assistance -- The plant visits have been initiated and 12 visits have been completed. While in each plant the engineering team collects energy consumption and economic data; the team also gathers the data needed to analyze the thermal efficiency of the principal energy consuming equipment. When energy wastage is encountered it is pointed out to plant personnel and, when appropriate, suggestions are made for correction.

The State Energy Office has initiated an energy consumption survey of the industrial sector of Georgia. We have worked with them to make their data compatible with ours and they will give us the results of their survey to add to our data.

Task IV: Data Analysis -- When the work sheets from each visit are completed, the data for that plant is analyzed and a report made. The analysis of the individual plant data is progressing along with the data collection with reports being completed within two or three days of the visit. (A sample report is attached.)

Task V: Develop Alternatives -- Energy conservation potentials for each plant are being developed during the visit and after reviewing the analyzed data. Work on this task has just started and no significant progress has been made.

Task VI: Workshops and Seminars -- Planning for the workshops has just begun.

Task VII: Reporting -- Upon completion of the analysis of the data obtained during a visit follow-up reports are sent to the plant managers. These reports summarize the team's fundings and suggest energy conservation measures where appropriate.

No significant difficulties were encountered.

It is anticipated that the following will be accomplished on the tasks during the coming quarter:

Task III: Data Collection and On-Site Technical Assistance -- It is anticipated that this task will be completed, except for some follow-up visits by the end of this quarter.

Task IV: Data Analysis -- Analysis of the individual company data will be completed and analysis by industry groups and by processes will be nearing completion by the end of the quarter.

Task V: Develop Alternatives -- The visit reports and the data analysis results will be used to develop individual plant and industry-wide energy conservation potentials. Where possible, economic data will be used to evaluate alternative conservation methods.

Task VI: Workshops and Seminars -- It is anticipated that the workshops will have been developed and underway.

Respectfully submitted,

John W. Tatom
Principal Research Engineer

edh

Enclosures (as stated)
cc: Mr. L. J. Phillips

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

March 11, 1975

Mr. Alfred E. Diamond
Economic Development Administration
United States Department of Commerce
Washington, D. C. 20230

Subject: Technical Assistance Project #99-6-09359, Quarterly Progress Report #3 for Period of December 10, 1974--March 9, 1975.

Dear Al:

During the past quarter, the following work was accomplished on the tasks shown below:

Task I. Analysis of Data on Hand. While the major part of this task has been completed, a continuing effort to collect data from outside sources, which may reflect on the program, remains.

Task II. Engineering Analysis Planning. Again, while this task has been essentially accomplished, minor modifications to the on-going site visit program are occasionally made as they are required to accommodate new situations.

Task III. Data Collection and On-Site Technical Assistance. The plant visit program, originally planned to include a total of 35 site visits with a team of three engineers, has now been completed and a new phase of this program initiated. Presently this new phase is in a planning period. The object of this second phase is to enlarge the coverage of the survey to include more industries, to cover a greater geographic area than was previously surveyed and to take advantage of comments and ideas forthcoming from the Conferences and Workshops that have now been initiated.

An expansion of the Energy Technical Assistance effort under the EDA energy program was conceptualized in the later part of February and is referred to as the Energy Technical Assistance Program. The purpose of this program is to identify energy related problems that face Georgia firms and to provide assistance. The Energy Technical Assistance Program will be conducted during the months of March, April and May. The Engineering Experiment Station's seven field offices will be utilized for the identification of firms who have immediate energy-related problems. The identified firms requiring energy assistance will be evaluated according to an energy criteria, ie., possible energy savings, and this energy ranking will be used to allocate the available funds for energy technical assistance.

The Georgia State Energy Office (SEO) in coordination with this program has begun to distribute an Energy Consumption Survey. (The survey instrument was prepared by EES personnel under this contract but it was convenient to have the SEO mail it out.) The survey was field tested with a mailing of 55 firms. Thirty percent was received from this initial mailing. From these 30 percent returns and various telephone conversations to companies who did not respond, several revisions were made to the survey. Using the Georgia Department of Labor's listing of manufacturing firms, 2,400 firms were randomly selected within Georgia using the three digit SIC level. EES then provided the SEO with a mailing list of these 2,400 companies along with the survey instrument. The survey was mailed by the SEO, February 10, 1975, and as of this date 310 responses have been received.

In general the questionnaires were useable however, some problems were encountered, ie., data missing, units not matching, etc. The SEO is contacting individual companies directly in cases of incomplete data. Early next week, the second mailing list will be sent out by the SEO. We estimate that 60-70 percent returns will be forthcoming. Also a key punch form has been developed, which allows for the information on the survey to be transferred to data cards. Initial work on constructing a program to be used in analyzing the information obtained from these 2,400 firms has been achieved. A copy of this survey instrument is enclosed.

Task IV. Data Analysis. The data analysis is a continuing effort and involves some iteration, since data necessary to the conduct of the program is occasionally lacking. Thus some of the visited firms are recontacted and the required information obtained. A substantial portion of this effort is involved in breaking down the surveyed industries into the various processes involved, the amount of the total energy each consumes, the efficiency of this consumption, and the potential for improvement. This information should provide a sound basis for future programs for upgrading the operating efficiency of these surveyed industries.

Task V. Develop Alternatives. Out of the site visit program and from other sources, many techniques for saving energy are evolving. These involve both short and long term methods requiring in some cases the addition to or modification of process equipment. Scheduling changes, better utilization methods, employee participation, etc., are all means that are being developed as ways to reduce energy consumption and improve operating efficiency.

Task VI. Workshops and Seminars. We have now held our first Conference and have scheduled the first six as shown below in conjunction with the various local sponsors indicated.

Athens, Georgia	March 6, 1975 (1:00 to 4:00) Local Sponsor--Northeast Georgia Area Planning and Development Commission
Columbus, Georgia	March 13, 1975 (2:00 to 5:00) Local Sponsor--Lower Chattachoochee Area Planning and Development Commission
Albany, Georgia	March 18, 1975 (1:30 to 4:30) Local Sponsor--Southwest Georgia Area Planning and Development Commission
Macon, Georgia	March 19, 1975 (1:30 to 4:30) Local Sponsor--Middle Georgia Area Planning and Development Commission
Brunswick, Georgia	April 2, 1975 (1:30 to 4:30) Local Sponsor--Coastal Area Planning and Development Commission
Savannah, Georgia	April 3, 1975 (1:30 to 4:30) Local Sponsor--Coastal Area Planning and Development Commission

Another conference is scheduled to be held in Dalton, Georgia, but firm commitments have not been arranged. These conferences are primarily directed toward obtaining management support for energy conservation.

Currently we are preparing a second more technical phase of this program to be conducted at the same locations. The latter workshop phase of the program will be directed toward the lower level management and provide a means to implement the methods for energy conservation, monitoring of energy utilization, etc., developed in the first conference series.

Enclosed are various announcements and handouts from the first conference.

Task VII. Reporting. Upon completion of the analysis of the data obtained during a visit, follow-up reports are sent to the plant managers. These reports summarize the team's findings and suggest energy conservation measures where appropriate.

No significant difficulties were encountered.

It is anticipated that the following will be accomplished on the tasks during the coming quarter:

Task III. Data Collection and On-Site Technical Assistance. This task will be completed.

Task IV. Data Analysis. This task will be completed and the results compiled for inclusion in the final report.

Task V. Develop Alternatives. The visit reports and data analysis results will be used to develop individual plant and industry-wide energy conservation potentials.

Task VI. Workshops and Seminars. This task will be completed and a full report of this activity compiled for inclusion in the final report.

Task VII. Reports. A final report will be prepared.

Respectfully submitted,

John W. Tatom
Project Director

JWT/edh

Enclosures (as stated)

A-1644

ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 2, 1975

Mr. Alfred E. Diamond
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20230

Subject: Technical Assistance Project #99-6-09359 Quarterly Progress Report #4 for Period of March 10, 1975 to June 9, 1975

Dear Al:

During the last quarter, the following work was accomplished on the tasks shown below:

Task I. Analysis of Data on Hand. This work was at a low level of effort as relevant outside information continues to come in.

Task II. Engineering Analysis Planning. This work has now been completed.

Task III. Data Collection and On-Site Technical Assistance. The last of the plant visits have now been made and the total number of these visits stands at 45. It was hoped that more visits could be made but personnel conflicts in the conduct of the Conference-Workshop series prevented the total from being greater.

The mail survey conducted through the State Energy Office has also been completed. A total of 2,303 companies were surveyed, of which 1,211 responded and of these 733 surveys were useable.

Task IV. Data Analysis. This phase is essentially complete. Tentative results are being tabulated and projections of the energy conservation potentials of the various Georgia industries prepared. This represents a very large amount of material and will not be included here to avoid duplication with the annual report which will be submitted by August 31, under the revised program schedule.

Task V. Develop Alternatives. A table of energy saving techniques for each industry involved in the site visit program has been compiled. Estimates have been made as to the percent improvements in the utilization of energy associated with each of these methods. The methods include suggested changes in plant maintenance, operations, and schedules, and also include major improvements involving modifications to existing equipment or purchases of new facilities.

Task VI. Workshops and Seminars. This was the major activity of the reporting period and included a total of seven conferences and eight workshops involving a total of approximately 230 attendees. With one exception this program has been completed. The program was well received and much press, radio and TV coverage was provided by the local media. Out of these meetings a much improved line of communication between the EES and the participating industries was established; and an improved understanding of the problems facing industry was gained. Because of the bulk of the material covering this phase of the study to be included in the final report, it will not be presented here.

Task VII. Reporting. The preparation of the final report has begun and a partial preliminary rough draft compiled. While much remains to be done, substantial progress in this area has been made.

It is anticipated that the following will be accomplished on the indicated tasks during the coming quarter.

Task VI. Workshops and Seminars. A final meeting in Atlanta with the local trade groups and industry associations has been scheduled for July 2, 1975. At this meeting the implications of the present study will be considered and the participation of these organizations in the establishment of energy norms and energy conservation programs will be discussed. It is hoped that out of this meeting a mechanism for involving industry in the solution to the energy problem can be devised.

Task VII. Reporting. This will represent the major activity of the next several months. Preliminary estimates indicate that the final report can be held to approximately 100 pages. Every effort will be made to avoid publication of a lengthy, cumbersome document of little interest. Instead it is planned to include (largely uninteresting) supporting information such as the site visit reports, etc. in separate supplementary material provided to the sponsor but not included in the formal report. The report itself will be limited to pertinent information of more general interest.

If you have any questions or comments please contact me.

Yours Sincerely,

John W. Tatom
Project Director

JWT/edh

A-1644

STATE ENERGY OFFICE

7 Hunter Street, Rm. 145
Atlanta, Georgia 30334
(404) 656-5176

LEWIS C. SPRUILL
Director

February 5, 1975

Dear Sir:

The State Energy Office was established to administer the allocation of the state's reserves of petroleum products and to advise the Governor and other state officials on energy matters. Information on energy use is needed in order to develop energy policy alternatives and to assure fair fuel allocation procedures.

The enclosed questionnaire has been developed to obtain the necessary energy consumption and economic data from the industrial sector. The questionnaire is being sent to a number of the industrial firms in the state. Your answers to the questionnaire will be grouped with similar firms to insure that individual company returns will be kept confidential.

Please complete the parts of the questionnaire which apply to you and return it in the enclosed envelope. If you have any questions concerning current energy problems, please send a letter explaining your situation or give us a call, (404)656-5176.

Your cooperation and prompt attention in this matter will be greatly appreciated.

Sincerely,

Lewis C. Spruill

Lewis C. Spruill
Director

LCS:cja

STATE ENERGY OFFICE
ENERGY CONSUMPTION AUDIT

CODE NO.____________

SIC NO.____________

COUNTY ____________

OUTPUT DATA

1. What were your 1973 sales in dollars?____________

2. What was your 1973 production in units (lbs., etc.)?

   Quantity____________ Units____________

3. What was your 1973 average employment?____________

4. What was your production schedule in 1973?

   Days per year________ Shifts per day________ Hours per shift________

ENERGY DATA

5. Circle "P" for primary and "S" for secondary (i.e., backup fuel used when your primary supply is interrupted) for those fuels you used in 1973 (excluding transportation).

Electricity	1. P	2. S		Fuel Oil	1. P	2. S
Natural Gas	1. P	2. S		Coal	1. P	2. S
LP Gas (Propane)	1. P	2. S		Other	1. P	2. S
				What type? ____________		

6. Please estimate the percentage of each type of fuel used (excluding transportation) in 1973 for:

	Electricity	Natural Gas	LP Gas	Fuel Oil	Coal	Other
(a) Space Heating and Air Conditioning	____%	____%	____%	____%	____%	____%
(b) Processing/ Production	____%	____%	____%	____%	____%	____%
(c) Fuels used but not counted in (a) and (b) above	____%	____%	____%	____%	____%	____%
	100%	100%	100%	100%	100%	100%

7. Please estimate your total energy cost in 1973 (excluding inventory changes).

1973 Cost of Energy

Electricity	$____________	Fuel Oil	$____________
Natural Gas	____________	Coal	____________
LP Gas	____________	Other	____________
			____________

8. Please estimate the percentage of your total cost of production represented by your energy costs. ________%

(continued on back)

9. Transportation Energy Consumption in 1973

(a) Please estimate the percentage of each type of fuel used in 1973 for:

	Gasoline	Diesel	Other
(1) On-road use	____%	____%	____%
(2) Off-road use (i.e., forklifts)	____%	____%	____%
(3) Fuels used but not counted in (1) and (2) above	____%	____%	____%
	100%	100%	100%

(b) Please provide the following information on your transportation fuel use in 1973:

	Quantity (in gallons)	Cost (in dollars)
Gasoline	________	________
Diesel	________	________
Other	________	________

10. Electricity Consumption in 1973

Please provide the following information from your monthly electrical bills for 1973:

	Quantity (in kwh/mo.)		Quantity (in kwh/mo.)
January	________	July	________
February	________	August	________
March	________	September	________
April	________	October	________
May	________	November	________
June	________	December	________
			________

11. Did you use natural gas in 1973? (____Yes ____No; if not, please go to question 12.)

(a) The billing procedures used by different gas companies vary; please indicate the quantity measurement shown on your bill.

________therms

________c.f. at ________ BTU/c.f.*

________c.c.f. at ________ BTU/c.f.*

________m.c.f. at ________ BTU/c.f.*

* If BTU/c.f. is not shown on the bill, please list your gas supplier.

____

CODE NO.__________

(b) Please provide the following information from your monthly natural gas bills for 1973 (Units________________________):

	Quantity/Mo.		Quantity/Mo.
January	________	July	________
February	________	August	________
March	________	September	________
April	________	October	________
May	________	November	________
June	________	December	________
			________

12. Did you use LP gas (propane) in 1973? (____Yes ____No; if not, please go to question 13.)

(a) Please provide the following information from your LP gas bills for 1973:

Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
1	________	7	________
2	________	8	________
3	________	9	________
4	________	10	________
5	________	11	________
6	________	12	________
			________

(b) Storage capacity: __________gallons

13. Did you use fuel oil in 1973? (____Yes ____No; if not, please go to question 14.)

(a) Please provide the following information for each fuel grade for 1973:

Fuel Grade	Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
No.____	1	________	7	________
	2	________	8	________
	3	________	9	________
	4	________	10	________
	5	________	11	________
	6	________	12	________
				________

(continued on back)

Fuel Grade	Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
No.____	1	________	7	________
	2	________	8	________
	3	________	9	________
	4	________	10	________
	5	________	11	________
	6	________	12	________
				________

(b) Storage capacity: Fuel Grade No.________ Gallons________

Fuel Grade No.________ Gallons________

14. Did you use coal in 1973? ____Yes ____No

(a) Please provide the following information from your coal bills for 1973:

Type of coal________________

Delivery	Quantity (in tons)
1	________
2	________
3	________
4	________
5	________
6	________
	________

(b) What is the average inventory level of coal you maintain?

____

15. Respondent's Name ____________________Title____________________

Please return the questionnaire in the enclosed stamped, self-addressed envelope or to:

State Energy Office
Room 145
7 Hunter Street, S. W.
Atlanta, Ga. 30334

AGENDA

WELCOME .... PROGRAM INTRODUCTION

ENERGY: THE CRITICAL CHOICES AHEAD

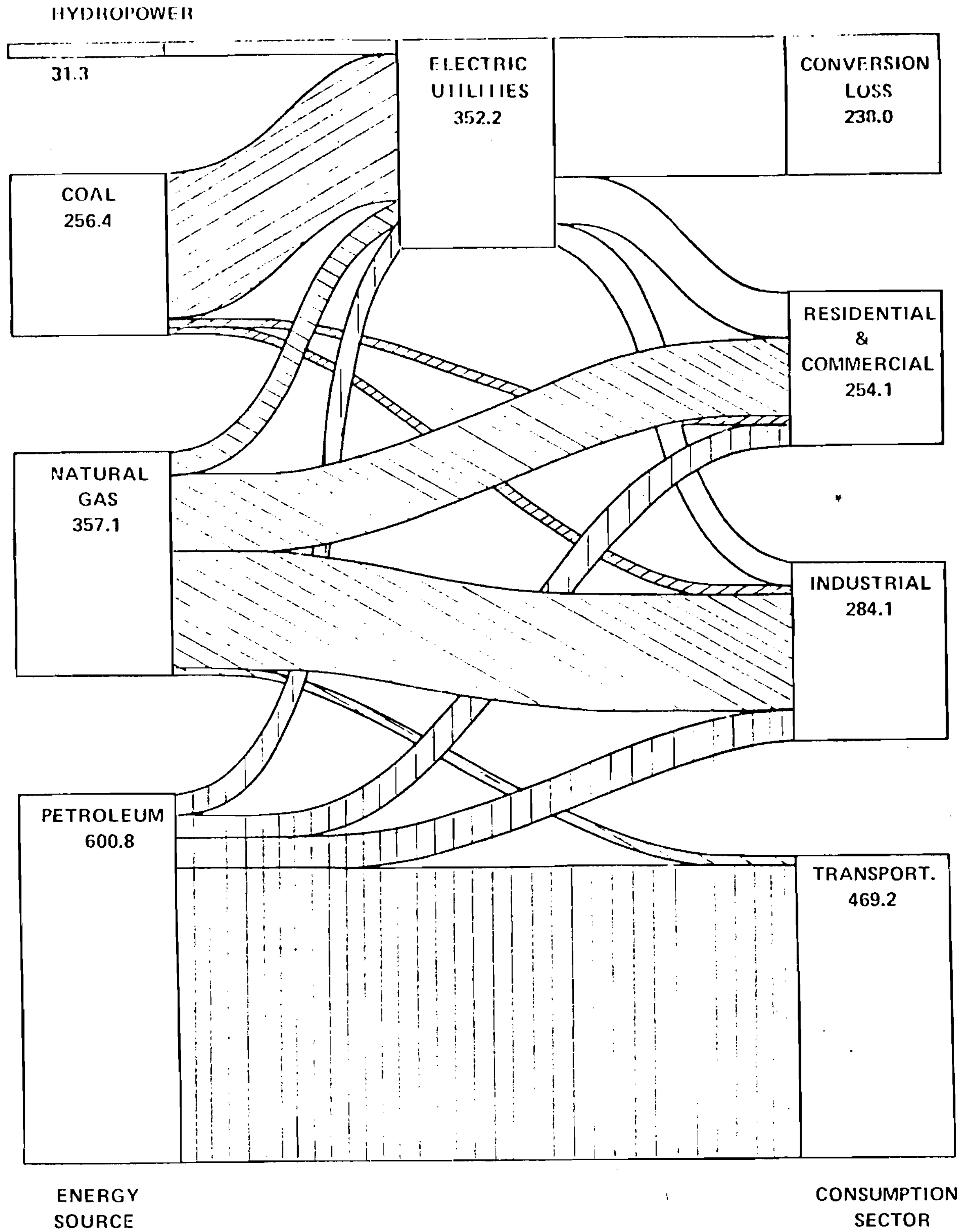
SUMMARY OF CURRENT GOVERNMENTAL POLICIES AND PROGRAMS THAT AFFECT INDUSTRIAL USE AND ASSISTANCE FURNISHED BY STATE ENERGY OFFICE

ENGINEERING APPROACH TO ENERGY CONSERVATION

DEVELOPING AND INSTALLING THE IN-PLANT ENERGY CONSERVATION PROGRAM

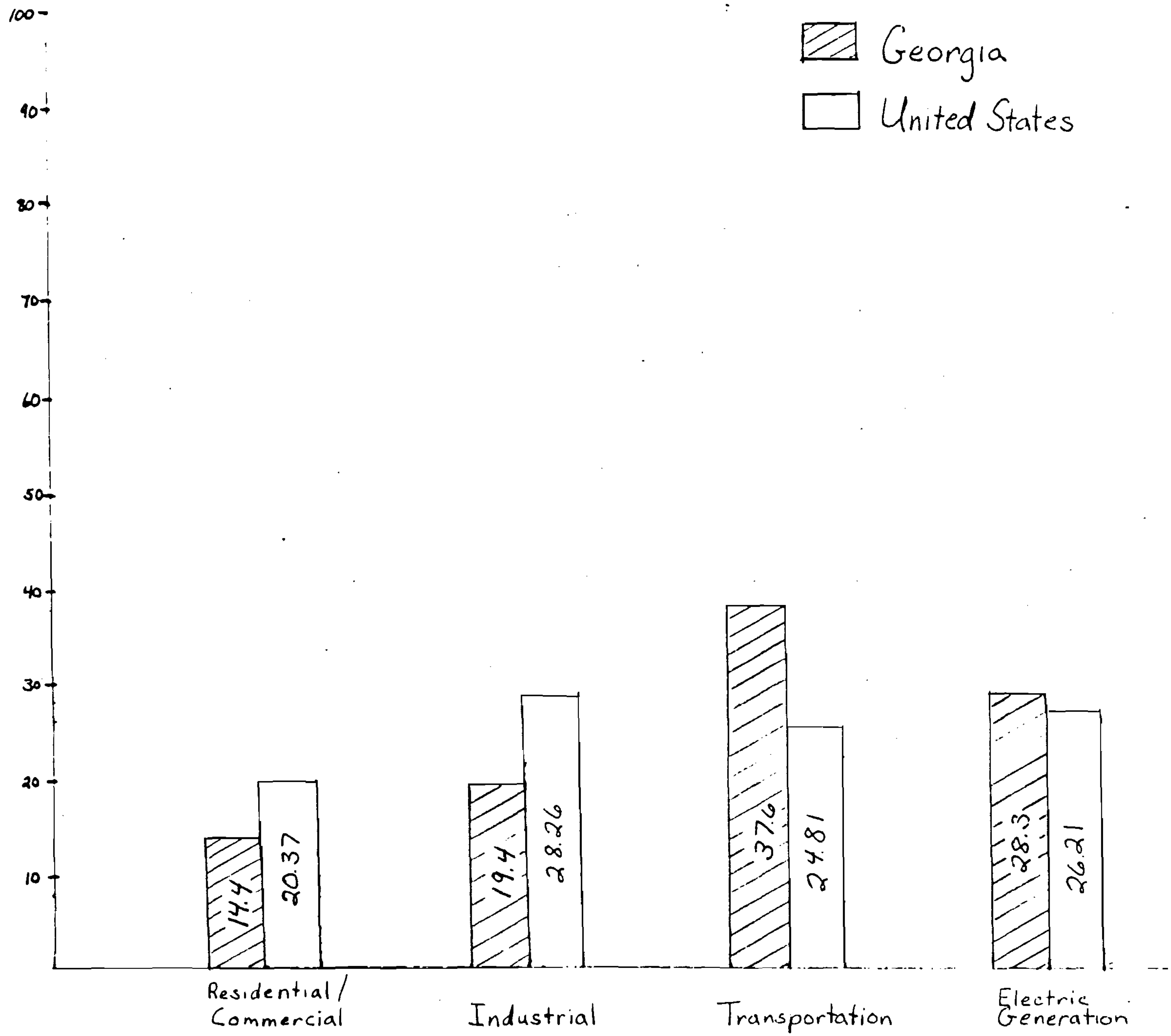
ENERGY CONSERVATION OPPORTUNITIES

WHERE DO WE GO FROM HERE?
(QUESTIONS AND ANSWER SESSION)

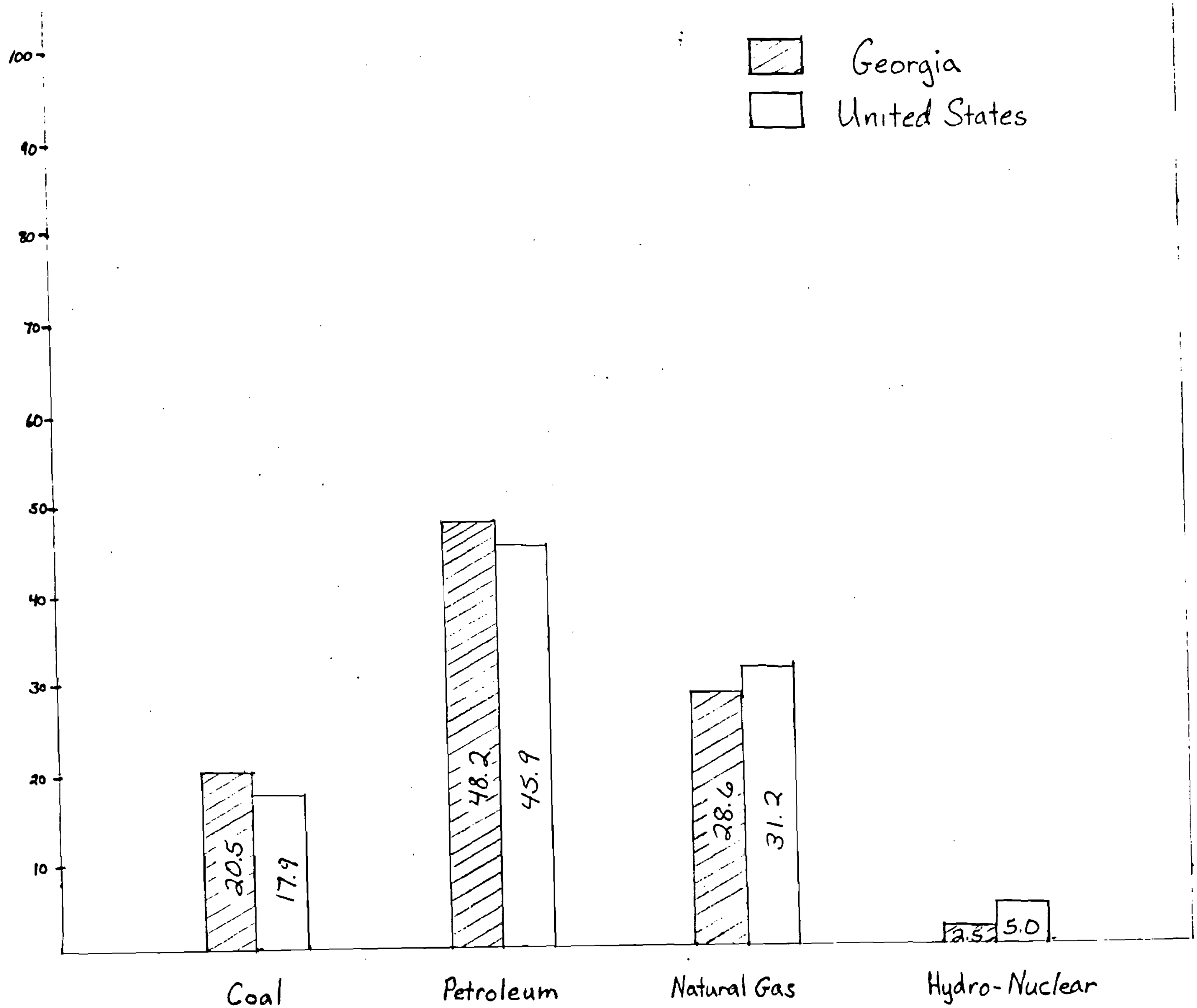


ENERGY FLOW
STATE OF GEORGIA
1973

TRILLIONS OF BTU'S



Comparison of % Consumption by Economic Sector in Georgia and the United States for the Year 1973.



Comparison of % Consumption of Fuel Resources by Georgia and the United States for the Year 1973.

PRESIDENT FORD'S ENERGY PROPOSALS

- IMPORT FEES TOTALING $3/BBL
- BACKUP IMPORT CONTROL PROGRAM
- DECONTROL OF OLD OIL PRICES ON 4/1/75
- PETROLEUM EXCISE TAX OF $2/BBL ON ALL DOMESTIC CRUDE OIL
- DEREGULATION OF NEW NATURAL GAS
- NATURAL GAS EXCISE TAX OF 37¢/MCF
- AUTHORIZATION FOR TARIFFS, IMPORT QUOTAS, IMPORT PRICE FLOORS, OR OTHER MEASURES TO ACHIEVE DOMESTIC ENERGY PRICE LEVELS NECESSARY TO REACH SELF-SUFFICIENCY GOALS
- STANDBY AUTHORITY TO DEAL WITH EMERGENCIES INCLUDING: IMPLEMENTATION OF CONSERVATION PLANS; ALLOCATION, RATIONING, AND PRICE CONTROLS ON FUEL; REGULATION OF PETROLEUM INVENTIORIES; AND ALLOCATION OF MATERIALS NEEDED FOR ENERGY PRODUCTION
- INCREASE FOR ONE YEAR IN INVESTMENT TAX CREDIT TO 12%
- THERMAL EFFICIENCY STANDARDS FOR ALL NEW HOMES AND COMMERCIAL BUILDINGS
- MANDATORY ENERGY EFFICIENCY LABELING ON ALL NEW APPLIANCES AND AUTOS
- WINDFALL PROFITS TAX TO TAKE 88% OF OIL COMPANY WINDFALL PROFITS
- DEVELOP AND INCREASE PRODUCTION OF NAVAL PETROLEUM RESERVES
- AMENDMENTS TO THE CLEAN AIR ACT EASING STANDARDS TO ENABLE POWER PLANTS TO SWITCH FROM OIL AND GAS TO COAL.

SOME CONGRESSIONAL ALTERNATIVES

- PHASE IN THE DOMESTIC OIL TAX ($2/BBL) AND NATURAL GAS TAX (37¢/MCF) OVER TWO YEARS

- CONTROLS WOULD CONTINUE ON THE PRICE OF "OLD" CRUDE OIL BUT WOULD BE RAISED BY $1/BBL EACH YEAR FOR 5 YEARS BEFORE TOTAL DECONTROL WOULD BE CONSIDERED

- AN ANALOGOUS PHASED DECONTROL OF NEW NATURAL GAS PRICES

- EXISTING MANDATORY ALLOCATIONS, IMPORT QUOTAS, AND IF NECESSARY, "SIMPLIFIED" GASOLINE RATIONING SHOULD BE USED TO GUARANTEE A MILLION BARREL PER DAY REDUCTION OF IMPORTS OF 1975 AND TWO MILLION BARRELS PER DAY BY 1977

- AUTHORIZE MANDATORY ENERGY CONSERVATION

- ALLOCATION SYSTEM MIGHT BE EXTENDED TO COVER COAL AS WELL AS OIL

WE NEED YOUR HELP

On Evaluation Of The Conference

This conference on in-plant energy conservation was designed to help management of industrial concerns place into proper prospective their energy problems; to illustrate that opportunities exist for energy cost reduction; and to furnish guidance in establishment of in-plant energy conservation and management programs. In order that we may make future conferences better, we want and need your ideas, suggestions and criticisms. Please complete the following sentences.

1. Probably, the greatest single benefit I derived from this conference was ___

___

___

___

2. The subject discussed that made the biggest impression on me was ___

___

___

___

3. I would really like to know more about ___

___

___

___

4. I was disappointed that you did not have more time for ___

___

___

___

(continued on next page)

On Information About Your Specific Energy Problem

If you have an energy or energy-related raw material problem, please let us know.

1. What specific energy problems have you identified which your firm faces today? ______________________________

____

____

2. Do you feel you can adequately measure the dollar impact of rising energy costs on your products?

   _____ Yes

   _____ No. What difficulties or problems do you have in dollar measurement? ___

____

____

____

3. What technical and management services do you have available for your energy problems? ______________________________

____

____

On The Material To Include In The Energy Technical Workshop

A technical workshop on in-plant energy conservation is being planned for the future. This workshop will be for the individuals in your plant who will be responsible for energy conservation. Please indicate what subjects would be of interest to your personnel.

_____ Energy usage related to heating and air-conditioning.

_____ Energy usage related to boilers.

_____ Energy usage related to machinery.

_____ Lighting.

_____ Energy-intensive process (e.g., dryers).

_____ Instrumentation for energy conservation.

_____ Identification of alternatives to energy-related raw materials.

_____ Other: ______________________________

____

____

On Registration For The Energy Technical Workshop And Information

Concerning In-Plant Technical Assistance

I (plan) (do not plan) to attend or send employees to the technical workshop on in-plant energy conservation. (An affirmative answer is not a commitment.)

I (would) (would not) like additional information concerning possible on-site technical assistance I can obtain from the Georgia Tech Engineering Experiment Station.

Name ______________________________

Company ______________________________

Address ______________________________

______________ Zip Code ________

A-1644

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

April 27, 1976

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject: Monthly Progress Report #1, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller business and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During this period efforts have been directed to developing a detailed project schedule and milestones, assembling the project team, establishing criteria for selection of companies to participate in development of case histories, developing a preliminary list of candidate firms, and developing training materials and a course to be used in preparing EES area engineers for energy conservation extension activities.

A detailed project plan and milestones were submitted to the Economic Development Administration on 22 April 1976. This plan was tentatively approved pending formal submission. The plan was formally submitted on 26 April 1976.

The project team was assembled and specific tasks were assigned according to the tentative project plan. The project team is divided into three major task areas: (1) Extension Engineers to serve as direct liaison with local companies, (2) Energy Conservation Engineers to perform technical assistance activities, (3) A support group to develop project case histories and technical information into transfer packages for use outside Georgia.

Criteria for selecting plants for participation in in-depth case history development were established and include:

(1) Use of Energy Intensive Processes
(2) Size of Total Industry Segment (potential for transfer to other companies),
(3) Management Interest,
(4) Size of Plant in Industry Segment,
(5) Degree of Existing Sophistication in Energy Conservation,
(6) Potential Impact of Energy Curtailment on Employment,
(7) Potential Cost Savings from Energy Conservation.

These criteria were transmitted to extension engineers and a list of candidate plants has been established.

Materials have been developed for use in an intensive three-day training course for extension personnel to be involved in this project. This course is designed to provide extension personnel with tools for providing specific energy conservation technical assistance to local plants. The course will be presented on May 5, 6, 7 at the Georgia Tech Campus. The course material will be documented in the final report as a part of the transfer materials package.

During the next period the training program will be conducted and a final list of plants to be included in case history development will be established. Work to develop program evaluation and case history formats will also be initiated. Specific technical assistance efforts will also be undertaken.

Respectfully submitted,

Jerry L. Birchfield
Project Director

A1644

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 14, 1976

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject: Monthly Progress Report #2, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller business and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During this period efforts have been directed to presenting a three-day intensive training course for project area engineering representatives, to selecting plants for participation as in-depth case study plants, to selecting firms for provision of technical assistance, to initiating in-plant conservation efforts in both categories, and in formation of a project advisory committee.

A three-day training course was held on May 5, 6, 7 at the Georgia Tech campus. Project field engineers were given approximately 30 hours of instruction and field experience in energy conservation practices during this course. Participants were given experience in the use of instrumentation, collection of equipment operating data, and specific methods for estimating conservation potentials available from alternative plant energy system modifications.

Firms were selected for participation in this project from candidate lists provided by area extension engineers and from other project staff and at the request of the companies involved. The most promising candidates were selected for in-depth case studies.

These include 26 firms in the following industrial categories:

Category	No. of Firms
Ceramics	1
Food Processing	6
Foundry	1
Mining	2
Stone and Clay	1
Paper and Paper Converters	5
Primary Metals	3
Textile Products	4
Transportation	1
Wood Products	2

In addition to these firms, 48 other firms have requested technical assistance under this project. Visits with the case history firms and the technical assistance firms have been initiated in this period and will be continued during the remainder of the project.

An advisory committee meeting will be held on June 15, 1976 during which the project objectives, current activities, and future directions will be discussed. Comments on future directions will be elicited from the advisory committee members and they will be requested to assist in dissemination of project results through their various organizations.

During the next period efforts will be directed to continuing work with plants and development and implementation of conservation programs.

Respectfully submitted,

Jerry L. Birchfield
Project Director

A-1644

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 28, 1976

Dr. Alfred Diamond
Economic Development Administration
U. S. Department of Commerce
Washington D. C.

Subject: Monthly Progress Report #3, Grant #99-6-09359-1 "A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller businesses and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During the period efforts have been directed to continuing work with the 17 companies contacted in earlier periods, to development and initiation of case studies, to development of the transfer package format and evaluation format, and to contact with additional firms that were initially selected, and to preparation of the 5th quarterly progress report.

Work with the 17 firms contacted previous to this period has continued and significant progress is being made in identifying conservation potentials and to motivating firms to implement conservation plans. Detailed descriptions of the company activities are given in the 5th quarterly progress report.

Work has also progressed toward building detailed case studies on the firms selected. Data describing energy usage, conservation potentials (with economic justifications) and company actions are being gathered and prepared for the case study packages. These case studies are also being prepared for insertion in the project methodology transfer package to be developed. Evaluation efforts will be initiated in the next period.

Also during this period four additional firms have been contacted including manufacturers of textiles, paper products, and metal products. At least one of these firms has already initiated an energy conservation project based upon staff recommendations.

During the next period contacts with companies will be continued with six more new contacts planned. Detailed planning for the seminars and workshops will be initiated and case study and program evaluation activities will be continued.

Respectfully submitted,

J. L. Birchfield
Project Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

November 5, 1976

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject: Monthly Progress Report #7, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller business and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During this period efforts have been directed to: 1) continued technical assistance to small businesses in the textile broadwoven industry, the box-board industry, the carpet industry, and the extruded metal industry. Also during this period a workshop, oriented to needs of the textile industry, was held in Dalton, Georgia and attended by approximately 50 industry representatives.

The attendee's evaluation of the workshop is attached. Also during this period the Industry Committee of the Georgia House of Representatives and business leaders of the West Georgia region requested that a meeting be held to examine energy options and impact of energy shortages on employment. This meeting has been planned and an agenda is attached. Development of a slide/tape show with interviews with plant managers has proceeded as has preparation of materials and case histories for inclusion in the project transfer package.

During this period, because of the request from the legislature, it was decided to delay the workshops which had been planned for November and December. All workshops are now planned for conduction in the last two weeks of January 1977.

During the next period preparation of the case history material will be continued and the meeting with the legislature and the business community will be held on November 23. Also plans for legislation to establish a state supported Energy Extension Service will be developed and forwarded to the state Office of Energy Resources and the House Industry Committee.

Respectfully submitted,

Jerry D. Birchfield
Project Director

2 Enclosures

WORKSHOP

Energy Conservation Systems

for the

Textile Processing Industry

Summary of Evaluation

Overall Impression	Number of Persons
Poor	1
Fair	4
Average	4
Good	11
Very Good	8

Topic Most Valuable	Number of Persons
Boiler	14
Energy Recovery	9
Dye Beck	7
Tenter Frame	5
Dryer Waste Reduction	5
Pre Drying	3
Energy Accounting	2
Dyeing	2
Floor Discussion	1

Topic Not Applicable	Number of Persons
Beck Drying	2
Dye Becks	2
Tenter Frames	2
Production Methods	1

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

December 7, 1976

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject: Monthly Progress Report #8, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller business and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During this period efforts have been directed to: 1) continued technical assistance to small businesses in the primary metals and food processing industries, 2) to preparation and conduction of a seminar for management, financial, and government leaders in West Georgia, 3) to preparation of final report material, and 4) scheduling and preparations for four additional workshops to be held January 25, 27, 31 and February 3, 1977 in Carrollton, Macon, Savannah, and Atlanta, Georgia.

The seminar for West Georgia businesses was developed specifically for orientation of business and financial leaders concerning specific conservation technologies and concomitant financial needs. The meeting was held at West Georgia College and was attended by approximately 60 persons. A copy of the program is attached.

Preparation of final report materials including case study write-ups, workshop transcripts, transcript of field agent training program, slide/tape presentation, etc. have continued. The case study materials will be organized according to industry groupings with general and specific company data included.

Four additional workshops for industry are being planned for early 1977. These include two general manufacturing industry workshops, an apparel industry workshop, and a stone, clay, and primary metals workshop. These are being presented in conjunction with various trade associations.

During the next period primary attention will be placed on continued final report preparation and on preparation for the four seminars.

Respectfully submitted,

Jerry L. Birchfield
Project Director

Enc.

November 23, 1976

1:30 p.m.	Registration
2:00 p.m.	Welcome--A. Maurice Townsend President West Georgia College Dr. T. A. Stelson Georgia Tech Research Institute
2:10 p.m.--2:40 p.m.	The National Energy Picture to 1990 J. L. Birchfield, Georgia Institute of Technology The Georgia Energy Forecast til 1990 Steven Day Georgia Institute of Technology
3:10 p.m.--3:40 p.m.	The Technologies That Will be Required J. L. Birchfield Georgia Institute of Technology
3:40 p.m.--4:00 p.m.	The Financial Requirements to Meet Energy Needs Dr. Fred Tarpley Georgia Institute of Technology
4:00 p.m.--4:20 p.m.	The Impact of Energy Shortages on Employment R. L. Yobs Georgia Institute of Technology
4:20 p.m.--4:30 p.m.	Break
4:30 p.m.--6:00 p.m.	Panel Discussion Chaired by: Rep. Tom Glanton Robert Sherer, R. L. Yobs, T. E. Stelson, J. L. Birchfield Dr. Joseph Pettit, J. T. LaBoon*
6:00 p.m.--7:00 p.m.	Mixer
7:00 p.m.	Dinner Speaker: Ms. Omi Walden Office of Energy Resources State of Georgia

*Tentative

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

February 15, 1977

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject: Monthly Progress Report #10, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

Gentlemen:

The objectives of this project are: to develop in-depth case studies showing the value of energy conservation programs in reducing costs of production in smaller business and fragmented manufacturing industry, to provide specific technical assistance to firms desiring to reduce energy consumption, to perform a continuing evaluation of the project impact, and to develop materials which can be used to transfer the project knowledge to other states.

During the month of January material for energy conservation workshops was assembled, the audio-visual presentation on energy management was completed, case study documentation continued, and two energy conservation workshops were held.

Material for use in workshops on energy conservation included 35 mm slides depicting the current energy situation nationally and locally, slides explaining the various stages of heat recovery in boilers, transparencies showing methods of determining insulation efficiency, and "handouts" on:

- HVAC Energy Conservation
- Electric Power Demand
- Drier Operations
- Fuels and Combustion
- Solar Heating
- Energy Conservation Reports from the American Meat Institute
- Process Case Studies Resulting from the Georgia Tech work under this contract.

Audio-visual presentation editing and slide selection was completed in January. The presentation, a part of the transfer package, is 18 minutes in length and includes approximately 60 slides. The presentation is primarily composed of edited comments by a number of industry representatives in various capacities in Georgia. The presentation is organized to include recent results of energy conservation measures, comments of energy availability, management techniques used to operate energy conservation programs, and pointers on starting an energy conservation program.

Case study documentation is proceeding well. An outline of a typical case study includes:

- Reasons for selecting the company
- Observations during initial visit
- Energy inventory results
- Data analysis results
- Recommendations
- Status of implementation of recommendation

Short descriptives of technical assistance to other companies (those not selected for case studies) are also being written; these will be included in the case study section of the Transfer Package.

An energy conservation workshop was held on January 31, 1977 in Savannah. (Another workshop was held in Atlanta on February 3.) Twenty persons registered for the workshop, although the natural gas shortage caused problems which prevented eight of those people from attending. The workshop was well received, and several attendees expressed a desire to send additional employees of their companies to future workshops.

During the month of February work will continue on case study documentation and two additional workshops will be promoted.

Respectfully submitted,

Jerry L. Birchfield
Project Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

March 15, 1977

Mr. Alfred Diamond
Economic Development Administration
U.S. Department of Commerce
Washington, D.C.

Subject:Monthly Progress Report #11, Grant #99-6-09359-1
"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast".

Gentlemen:

During the month of February, the third Advisory Committee meeting was held, the drafts of all case studies were completed, the drafts of the Transfer Package were continued, and arrangements for the final two workshops--to be held in March--were completed.

The third,and final, advisory committee meeting was held on March 8. The agenda for the meeting included a review of energy conservation technology developed or used on the project, a summary of the January workshops, and comments on the recent natural gas shortage and its effect upon Georgia Industry.

Drafts of all ten case studies and technical assistance cases were completed in February. These drafts will be reviewed and edited in March. Transfer package development continued in February with drafts of the section on Organization (for similar projects in other states) being completed. This section includes desired qualifications of project personnel. This section on Management was begun in February and will be completed in March.

Workshops on the topic "Energy Conservation Systems in Manufacturing Industries" are scheduled for March 22 in Rome, Georgia and March 24 in Athens Georgia. The Georgia Chamber of Commerce has been involved in the planning for these workshops and their mailing list was used for the mailing of workshop announcements.

An addition to the agenda of this workshop is a panel discussion of current and future energy supply situation, with the panel including representatives from the Georgia Power Company, the Atlanta Gas Light Company, Westinghouse Electric Company, Amoco Oil Company, and the consulting firm of Henningson, Durham and Richardson.

Mr. Alfred Diamond
March 15, 1977

Future plans call for the completion of the project in March and submission of the Final Report soon thereafter.

Respectfully submitted,

Jerry L. Birchfield
Project Director

R.L. Yobs
Laboratory Director

JLB:cw

Quarterly Progress Report # 5

EDA Grant #99-6-09359-1

"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

by

J. L. Birchfield
D. I. Willmer
G. C. Curtis
R. H. Fulford
G. Soora
W. T. Studstill
R. L. Hughey
W. C. Darley

July 1976

TABLE OF CONTENTS

1. Introduction

The goal of project #99-6-09359-1 is to reduce the impact of energy shortages and increased energy costs on employment and industrial expansion by creation and stimulation of industrial energy conservation programs. The project has several objectives including:

(1) Develop training materials for use by appropriate state agencies in encouraging industrial energy conservation,

(2) Develop in-depth case studies showing the economic benefit to be derived from company energy conservation programs,

(3) Provide technical assistance to industry in Georgia in energy conservation,

(4) Evaluate the impact of industrial energy conservation activities.

During the first quarter of the project significant progress has been achieved in meeting those objectives. The project staff has developed and conducted a training program for staff in the seven area offices that are maintained by Georgia Tech within the state of Georgia. This training program was designed to provide the engineers in these offices with the technical skills necessary for providing effective service to industrial clients in the state needing energy conservation technical assistance. A list of 25 candidate firms in twelve 2-digit SIC categories that are being considered for participation in case studies has been compiled and 17 of these firms have been visited by teams of engineers to gather energy data and to initiate conservation projects. Reception in these firms has been excellent and all have requested that they be included for in-depth case study development. A list of approximately 50 additional firms desiring technical assistance has been developed and scheduling of visits to these firms has been initiated.

The project staff has also developed formats for collection of energy data in the case study and technical assistance firms, formats for case study documentation, and materials for use in evaluation activities. These materials are described in this report.

Three general conclusions can be reached after the first quarter of work. First, there is significant interest in companies for assistance in developing conservation programs. Second, most firms recognize the need for and economic benefit of energy conservation but most firms do not have technical personnel with the training necessary to evaluate and select energy conservation modifications. Third, most firms contacted feel that rapid adoption of widespread industrial energy conservation programs will require a continuing federal government program of the type that is being conducted in Georgia.

The specific activities which have been conducted in the first quarter are summarized below.

2. Selection of Participating Companies and Company Visit Profile

Firms have been selected for participation in this project from those who were involved in EDA Grant #99-6-09359 and from those who were known by Georgia Tech Area Office personnel to have specific interest in receiving energy conservation assistance. Two types of firms were to be included in this project; those which would consent to being involved in in-depth case studies and those that required technical assistance on specific energy problems. Criteria for selection of case study companies were formulated by the project staff and by the area office staff and included the following major categories:

(1) Use of Energy Intensive Processes,

(2) Size of Total Industry Segment (potential for transfer of methodology to other similar companies),

(3) Management Interest

(4) Size of Company in Industry Segment,

(5) Degree of Existing Sophistication in Energy Conservation,

(6) Potential Impact of Energy Curtailment on Employment,

(7) Potential Cost Savings to be Derived from Energy Conservation.

Using these criteria a master list of approximately 100 firms representing those that were potential case studies was compiled. Subsequently, several meetings involving project staff and area office representatives were held and the list of 100 firms was narrowed to the twenty-five which showed greatest promise as case study firms. This selection process included telephone interviews with company personnel during which the project goal and objectives were explained, EDA's interest and involvement were communicated, and general company interest was ascertained. By this process firms having definite interest were included and those needing only technical assistance were identified.

After the candidate lists were developed visits to the case study firms were initiated. Since documented energy savings are desired it was necessary to initiate company activities as early as possible to allow for delays in equipment purchase and installation (at company expense). To date 17 of these firms have been visited by engineers on the project staff and initial efforts have been made to stimulate energy conservation activity within the companies. Of the 17 companies visited two have been found to be unsuitable for inclusion for case study purposes. Of these firms who were eliminated from further work one was found to have insufficient energy demand to justify conservation measures. The other firm purchases natural gas (the principal energy source) from a municipality. Since the company is a major user of gas in the system and since the municipality requires certain fixed revenues from gas sales no cost savings could be derived from conservation.

The 17 firms that have been contacted are in the following SIC categories:

SIC	Category	# of firms
20	(Food)	6
22	(Textiles)	3
23	(Apparel)	2
24	(Lumber)	2
26	(Paper)	1
32	(Mining, Ceramics)	2
33	(Metals)	1

Visits to these 17 firms have been arranged by area office representatives and have included several important components. A typical visit profile is described below.

The purpose of the project is explained to top company management personnel and any questions are fully answered. The role of Georgia Tech and EDA are explained to the company managers. After initial discussions the area office representative is assigned to collect all energy use data. A form has been devised for this purpose and is shown in Appendix A. A project engineer then makes a thorough survey of the plant energy system and develops a list of specific energy use questions which must be answered. Subsequently company or Georgia Tech project personnel are assigned to collect these data. Based upon analysis of these data specific conservation potentials including both energy units and dollar savings are developed and systems for realizing these savings are described to technical representatives of the firm. The conservation options are developed in coordination with the company personnel so that they can understand the rationale involved and can subsequently perform such studies without outside assistance. Specific plans for company action are then developed and schedules for implementation are developed. This general procedure has been found effective in all plants visited to date.

Descriptions of several company visits and analysis activities conducted to date are outlined below. Also, estimates of conservation potentials are included.

3. Company Activity Reports

The general method of operation with firms under this project is to initially visit plants, gather energy consumption and cost data, identify currently planned energy conservation activities and projects, and develop energy conservation options with supporting economic data in forms suitable for company management to make decisions. Care is being taken to work through existing company management channels and to demonstrate analytical methods (both technical and economic) to the appropriate company personnel so that after this project is completed the personnel will retain the skills necessary to initiate new conservation projects. Also in direct company contacts attention is being directed to demonstrating the validity of a comprehensive conservation activity that makes use of all appropriate technical resources in the firms. This approach will hopefully demonstrate the value of formal conservation programs and the management methods for implementing such programs. Several of these activities in various companies are described below on a company by company basis. The firms are not identified by name in order to protect company confidential data.

Company # 1-4

Company-Broiler Processing Plants - (Four Plants)

SIC 20

North Georgia

Broiler processing plants typically have a production of 80,000 birds per 8 hour shift. As received the birds are 6-7 weeks of age and dress out at two pounds. The principal processing steps are:

1. Hung on conveyor
2. Bled
3. Scalded - 130°F water
4. Feather removal
5. Eviscerated and washed
6. Chilled - 32° water

7a. Packed in ice or CO_2

7b. Frozen

The typical processing plant will use 8 gallons of water per bird.

The principal energy consuming systems are refrigeration, conveyors, scalding process hot water, clean up hot water, building heating and lighting. As a general statement the industry is under-engineered and significant savings are available in all listed energy systems.

The following is a listing of specific items and processes for which energy conservation measures have been implemented or are under study.

A. Scald Tanks - Scald tanks are constructed of 1/4" steel plate and are 30' x 7' by 3' deep. Insulation of these tanks will save 10% of the energy required by the process.

B. USDA requirements call for an overflow from the scald tanks at one quart of water per bird. In the typical plant this averages 20,000 gallons per day of 130° hot water. It is calculated that by use of a water to water heat exchanger transferring this over flowed water heat to the make up water, a reduction in heat requirements of 40% can be obtained.

C. Chilled Tanks - Chilled tanks are typically 8,000 to 12,000 gallon capacity containing 33°F water. Insulation of these tanks with polyurethane has proven to give a 15% reduction in refrigeration requirements.

Boilers - The boilers are typically oil and gas fired and the steam is used for scald tank water heating, for cleaning water heating and for space heating. A program is underway to train the boiler operators to use combustion test instruments for setting the burners. Savings of 4 to 5% in gas or oil are being experienced through improved combustion efficiency.

Steam Piping - The importance of steam main insulation and the correction of steam leaks is being demonstrated to plant operating personnel.

Bare 3" steam mains at 100 psig waste the equivalent of $4.65 per year per ft. as compared to the same main insulated to recognized standards. In one plant the insulation of the steam lines reduced consumption by 3% and had a return on investment of six months.

Refrigeration - A study is underway to consider the feasibility of recovering the condenser heat from the refrigeration systems for the heating of hot water for the scald tanks and for space heating. Ammonia refrigerant with its 250°F superheat and high condensing temperatures appears especially suitable for this purpose. Due to the relatively large requirements for refrigeration in broiler processing plants, it appears that enough heat may be available from this source to handle the entire heating load.

Company # 5

SIC 20

Southwest Georgia

Primary products of this company are fresh frozen vegetables and repackaged foods. The firm employs 600-1000 workers on a seasonal basis. The plant operates two shifts - five days per week. Major energy consuming processes include refrigeration, conveying, steam and hot water, and lighting.

In the plant vegetables are received directly from growers via truck and are subsequently washed, cut, blanched, quick frozen, packaged and warehoused prior to shipment to retailers. The plant operates a boiler and approximately 2400 H.P. of refrigeration equipment. The total energy bill for the plant exceeds $500,000 per year.

The company has initiated an energy conservation program and has established a conservation committee. The energy program coordinator is the company comptroller. The committee has only recently been formed and has operated only in a limited fashion. Installation of a demand controller is the only active project underway at present. No operating data is available from this system yet.

Several areas show considerable energy conservation potentials. Steam is produced by gas and oil fired boilers. Prime users of steam are for water heating and blanching. A study of energy required for blanching showed that current systems are operating at only 6% efficiency (based on specific heats of products and on required temperature rises).

Reasons for this low efficiency are being studied and preliminary information and analysis shows that considerable losses are occurring in:

a) Boiler combustion,

b) Steam line insulation,

c) Inadequate control of steam demand at blanching machines,

d) Hot water waste,

e) Steam leaks, and

f) Condensate return.

Projects to improve efficiency in each of these areas are being defined and will be communicated to the company. A goal of 50% reduction in these losses has been established with a resulting potential savings of $40,000 per year.

Another area of considerable conservation potential is in utilization of waste heat from the ammonia refrigeration system. By capturing this waste heat and directing it to the processes requiring heat complete replacement of the steam boiler could occur. Studies are underway to identify vendors of heat exchange equipment that could be used for this purpose. Potential savings through such a modification exceed $100,000 per year. This general area of conservation is very similiar to that in poultry processing facilities and since it has wide application will be documented as a case study.

Company # 6

SIC 20

Southeast Georgia

This firm receives, warehouses, and ships packaged frozen foods. Most of the products are received fresh and are quick frozen prior to warehousing. Principal energy demand is for electricity in warehouse temperature control and quick freezing operations. Quick freezing operations require approximately 75% of the plant electricity.

The company has requested general conservation assistance. A preliminary study showed that scheduling of quick freezing regrigeration compressors will allow peak demand to be reduced. Potential savings of $15,000 per year have been identified.

Company # 7

SIC 22

Northwest Georgia

This firm was established in 1968 and presently employs 39 people. Their main product is dyed yarn that is used in shag carpets. The company has two plants located about four miles apart. One of which does the dying and the other the drying. Yarn is received in large loose rolls and is dyed in closed dye becks in the first plant. Part of the water is removed with electrically driven centrifugal water separators after which the yarn is boxed and shipped to the other plant. In this second plant the yarn is dried in a gas fired dryer, mounted on skeins on cones, boxed and shipped to the customer. At present, the management has plans to move the dying plant to the location of the drying plant. During this move they see an opportunity to incorporate various energy conservation techniques in the layout of their new plant. The company is innovative and sees the potential for cost savings through energy conservation.

The main energy consuming systems in the company are dye becks and driers. The dying operation is carried out with boiling water. The becks are loaded with cold water and, unlike most carpet dye becks which use steam sparging to heat the water, these becks have closed steam tubes and use a heat exchanger at the bottom with a pump-around system on the water. Thermodynamically, this system is superior to direct sparging used in similar industries. The indirect heating techniques also allows many energy conservation techniques to be applied.

At present, the company has a unique system set up in their drying plant. The boiler is isolated in a small concrete block room and the drier exhaust is directed into this room for use as preheated combustion air. The boiler apparently is running without any problems. Though the boiler room is very uncomfortable due to the dryers' exhaust, this system provides a low cost air preheater for the boiler. However, boiler efficiencies are low at both plants due to high exhaust temperatures and represent a conservation potential.

Management intends to move the dying plant this year, which will give an opportunity to implement improvements that can be economically incorporated during construction of the new dye house. This should allow considerable energy savings over their present process. If in fact, the move is made prior to this winter and the ideas and assistance in energy conservation are incorporated for their new facility, considerable test data would be available by the end of the project. This company has potential as a detailed case study and will allow monitoring of data after implementation.

Company # 8

SIC 22

Northwest Georgia

This company was established in 1965 and employs about 1,650 people. The main products are tufted rugs and carpets. The company has a fully integrated plant with all manufacturing in one location.

The initial raw material is raw fiber which is processed into yarn. The yarn is tufted into carpets and then dyed in becks. The dyed carpets then have backings applied and then are dried in large drying ovens.

The annual energy bill for this firm is approximately two million dollars. Major energy consuming equipments of interest in terms of energy conservation potential are the steam sparged dye becks, the natural gas fired drying ovens, and the gas or oil fired boilers.

The dye becks used are typical of those in most carpet mills. They are initially charged with cold water that is then brought to a boil by sparging steam into the water. Thermodynamically, this is a very inefficient process. Efficiency and production could be improved by initially charging the becks with hot water.

Excessive steam is used in heating the water and maintaining a boil. With proper steam pressure control to the dye becks, controlled from beck temperatures, significant energy savings can be achieved. Heat can also be reclaimed from the spent dye liquor from the beck and then used to heat water for subsequent dying operations.

The present boiler capacity is 125,000 lb/hr and the company has plans to install an additional 50,000 lb/hr boiler. Preliminary analysis of energy recovery potential indicates that an equivalent 30,000 lb/hr of boiler capacity is available from waste streams. Through information made available by Georgia Tech personnel this company has postponed boiler expansion in order to investigate heat recovery alternatives. Apparent energy savings from waste heat recovery will exceed $300,000 annually.

The company was planning to install a heat recovery system on the gas fired dryers. These dryers use less gas and have a much lower stack temperature than the boilers. The dryer heat recovery project had a projected 17% return on investment. It was recommended that the company compare this return to boiler stack gas recovery. Upon investigation a boiler gas recovery system was found that has an 82% return on investment resulting from $65,000 annual fuel savings. The company has decided to have this system installed.

The company also has two chillers, with capacities of 1,500 and 600 tons, operating independently. If the two were connected together, energy savings could be achieved by diversity alone. This recommendation has been given to the firm and is being considered.

The company management has received the recommendations with enthusiasm and are planning to construct an energy conservation program based upon recommendations given by Georgia Tech. After talking with the personnel from Georgia Tech, they are considering creating a new position of Director of Utilities, whose task would be to initiate energy conservation ideas and evaluate proposals from a systems point of view. Based on the recommendations given, they are investigating the possibilities of heat recovery from the dye becks. They are also soliciting proposals for heat recovery systems for their boilers.

Company # 9

SIC 22

North Georgia

This firm employs approximately 142 employees. Primary products are scatter rugs, bath sets and bath carpets. Typical of most small carpet manufacturers they tuft, back, dye and dry. The majority of their $8,000 per month energy usage goes to dye and dry the carpets.

The company has one problem not found with most of the competitors - water treatment. Spent dye liquor is discharged into aeration lagoons to reduce BOD & COD. These lagoons require about 25 hp to drive mixers. These mixers were performing during peak load hours. A recommendation was made to use a time clock to operate these during the night. This change should save the firm over $2,500 per year in reduced electrical demand charges.

Their boiler is dual fuel, oil or natural gas, while the dryers can only be fired with propane. Conversion of the dryers to natural gas firing could save the firm a significant amount of energy. Savings of about $10,000 per year would result.

The company does not recover heat from spent dye liquor. The dye process uses would allow dye operations to start with hot water. If this hot water were generated by recovering waste heat from the process, savings on the order of $20,000 per year would result.

Company # 10

SIC 23

Southeast Georgia

This firm manufactures apparel products including quilted jackets, life jackets, and sleeping bags. Approximately 200 persons are employed. This firm initially requested technical assistance in energy conservation and to reduce airborne kapok lint in the jacket stuffing area. The solution to these problems involve several machine modifications and reduction in motor sizes from 32 horsepower to 8 horsepower. The firm was planning to purchase a $20,000 air filtering system requiring a 50 horsepower electric motor. This system is no longer needed and a direct savings in electricity costs of $4,700 per year is anticipated.

Company # 11

SIC 23

Southeast Georgia

This firm produces men's apparel and operates approximately 20 plants in the southeastern U.S. The firm employs approximately 600 persons at the facility which was visited. This plant operates 4 1/2 days per week and operates a limited second shift.

Primary energy use in the plant occurs in four operations: lighting, air conditioning, steam shaping and space heating. Electricity cost for the plant is approximately $105,000 per year. The building was constructed in 1967 but energy conservation was not a factor in the design. The company has an on-going energy conservation effort but the scope of the program is limited. This program has been restricted to general housekeeping items (lights and machines off when not in use, etc.) data collection of consumption, and installation of transient limiters. No significant energy reduction has occurred from these steps.

A site visit was made to the plant and several conservation potentials were identified. These are being analyzed to determine payback period and capital requirements. These potentials include the following:

1) Air Conditioning System

   The plant air conditioning system is comprised of 360 tons of refrigeration equipment. The plant has a high internal heat gain from people, motors, and lighting and as a result the air conditioning system is operated throughout the year. When the plant is in operation the outside temperature must be below 30°F before heating is required. The system can be modified to utilize an economizer air conditioning cycle using outside air during the winter months as a source for air conditioning rather than refrigerator compressors. Initial estimates show that utilization of an economizer cycle would reduce air conditioning cost by approximately 20%.

2) Roof Insulation

A significant part of the air conditioning load is contributed to heat gain through the plant roof. Approximately 96 tons of air conditioning are required to compensate for this gain. With the addition of six inches of fiberglass insulation the roof heat can be reduced by 86% requiring only 15 tons of air conditioning. The company is planning to re-roof the plant and will consider adding the extra insulation. It is estimated that this modification would reduce total air conditioning load by 22%.

3) Lighting

Average lighting levels in the plant exceed 90 foot candles illumination. For the type of operations being conducted 30 foot candles should be sufficient. Since lighting contributes a significant part of the plant heat gain this may be another method available for reducing air conditioning costs. Economic studies are currently underway to determine the benefit of reduced lighting levels.

4) Steam Boiler

The boiler has not been maintained at optimum combustion efficiency. Plans are underway to test combustion efficiency.

5) Electric Demand Control

Preliminary analysis of electric demand charges shows that electric load can be better balanced by a controller. This will reduce demand in the plant by about 300 KW and when coupled with roof insulation can result in approximately $12,000 savings per year.

6) Steaming Operation

Excess heat and humidity are added to the plant in the steaming operation. Studies are underway to modify vent hood design to capture this excess heat and moisture and exhaust it to the atmosphere rather than to the plant air conditioning system.

The possible savings in this plant approximate $35,000 per year or 30% of the electric utility cost. Since the plant is similar to many others in the U.S. it has been selected as a case study company.

Company # 12

SIC 24

South Georgia

This firm produces particle board from wood chips and binders. The plant operates three shifts per day seven days per week and employs approximately 350 persons. The physical plant is approximately five years old and is well maintained. An active energy conservation program has been underway for two years and has undertaken a number of small "housekeeping" measures and three significant projects requiring capital expenditures. These include:

1) Utilization of boiler exhaust gases as make-up for direct fired dryers,
2) Installation of a heat exchanger in the boiler blowdown line,
3) Utilization of combustible gases in boilers.

In addition to these projects several other potentials have been identified by the project staff and are being presented to the company. Enthalpy controls for use with gas fired dryers are being considered as replacements for currently used dry bulb temperature controls. Belt conveyors are being studied for use in replacing energy inefficient pneumatic transports at six points in the process. Conversion of flourescent lights to high pressure sodium lights, installation of skylights, and installation of photo-cell control of outside lights are all being considered as ways to reduce lighting costs. Demand control through operation of sanding operation during off-peak hours and installation of on-site demand recording meters is being evaluated. Natural gas conservation consumption can be reduced through installation of press-dryer steam line insulation and through control of boilers with combustion instrumentation.

Each of these alternatives is being studied to determine cost-benefit relationships. After these are completed the results will be furnished to the company and capital expenditure plans will be developed.

Company # 13

SIC 24

South Georgia

This firm produces wood products including kiln dried and pressure treated lumber for the construction industry. The company employs 300-500 persons (depending on the market) and operates three shifts five days per week. Primary energy consuming systems are conveying, sawing, and steam production. This is a relatively large production facility incorporating labor efficient materials handling equipment. The company also has an aggressive energy conservation program underway.

The firm is studying several areas for reducing consumption including pre-drying of bark fuel with flue gasses for the bark fired boiler and a study of demand control for electric equipment. Studies of alternative conveyor systems are underway to improve energy efficiency by selecting the most efficient equipment. At present steam quantity control in several processes is inadequate. It is anticipated that more accurate control of steam demand can significantly reduce consumption. Initial estimates show that savings in this area may be sufficient to eliminate the need for additional boiler capacity.

The progress of studies underway by this firm will be monitored. Specific technical assistance has been requested in the several areas described above and will be documented as part of this case study.

Company # 14

SIC 26

Central Georgia

This firm produces paper packaging materials including corrugated boxes. The plant operates three shifts per day - seven days per week and employs approximately 2,000 persons. Principal energy consuming systems include steam boilers and electric drives for printing presses and die cutting machines.

The company has had an energy conservation program underway for four years and has installed a computerized demand control system to control electrical loads. No significant savings have been achieved with this system.

The company has not actively considered boiler energy conservation through combustion efficiency improvements or through steam demand control at machines. As a result of this project a periodic combustion efficiency test program is being considered which is anticipated to reduce natural gas demand by 5%. Operational procedures have been initiated to secure steam supply to a paper coating line. A steam control procedure has been written into the operating instructions on this machine.

Company # 15

SIC 32

South Georgia

This firm is a major producer of kaolin. Kaolin is a very fine, high quality clay used to produce the white color in paper, cartons, and ceramic products. The plant employs 80 people. It is fully integrated having mining and processing under one management. The mined kaolin has a very fine partical size in the range of one to two microns. It is shipped by rail to customers with a moisture content of less than 1%.

The major operations of this company include mining, milling, separation and drying. Large quantities of water are used to separate and transport the kaolin through the processing. Electrical energy is required to pump water to the mine, kaolin slurry to the plant, and water to the plant. The major energy consuming process is the drying operation. The first stage of the drying is accomplished with large vacuum filters requiring approximately 1,000 horse power for vacuum pumps. This operation reduces the moisture content from 70% to about 50%. Large direct gas or oil fired dryers are then used to reduce the moisture content below 1%.

Energy savings may result from improvements in the vacuum filtering process. One possibility, pressure filteration, is being investigated. This does require a process change and should be first tested on an experimental basis. There is a possibility of altering the energy demand control on the water supply system since demand savings are possible by pumping the large amounts of water during off peak hours.

A demand control system alone may not be sufficient since additional pumps may be required to increase capacity for a reduced running time. The potential savings available could exceed $100,000 per year, however, and continued assistance is being provided to evaluate the possibility.

The firm is also experimenting with heat recovery from large direct fired dryers. Since the gas leaving the dryers is below 200 degrees, little heat can be recovered without condensation and savings would only be marginal. The dryer gas contains significantly less heat than the boiler stack gases and is more difficult to recover. Since 100% make-up boiler water is required the make-up can be used to reclaim the heat in the boiler stacks. Application for this purpose should save over $30,000/year and would cost less than $40,000.

Company # 16
SIC 32
East Georgia

This firm was established in 1969 and has an employment of about 120 people. The main products are vitreous plumbing fixtures including sinks, toilets and other domestic ceramic fixtures.

The basic raw material is fine powdered clay and is mixed with 200^{o} water to form a slip. The slip is stored in tanks and is constantly agitated. It is then pumped into molds. The molds are allowed to dry over night in a large gas heated room. The formed parts are then removed from the molds and allowed to dry and cure for the next seven days. After this drying, they are sent into a tunnel kiln where they are baked at 2200^{o}F. The product is then inspected and shipped. The damaged or defective parts are repaired if possible and refired in a refire kiln. About 10% of the products go through the refire kiln.

The annual energy bill is about $250,000 per year. The major energy consuming equipments are two tunnel kilns, two shuttle kilns, a boiler and gas space heaters for the drying areas. Large volumes of air are used in the tunnel kiln for combustion as well as for cooling the products. The kiln operates on a 24 hour basis. The combustion stack gas temperature is very low for heat recovery purposes but the cooling air stack temperature is approximately 370^{o}F and heat recovery from this air is possible.

The heat may be used in two ways; one would be to recover the heat available and produce slip water and supplement product drying. The other would be to use the hot air as preheated combustion air in a hot water heater and supply all the drying requirements with hot water. Savings of $20,000 and $50,000 per year respectively may result.

Another strong potential is the conversion of the shuttle kilns from gas to electric heating. The current efficiency of the shuttle kilns is approximately 10-15%. Electric heat in the shuttle kiln could be provided at 85-90% efficiency. Since electric energy during off-peak hours costs about four times current natural gas rates, the firm could save 30-60% by converting to electric heat. This change would result in an annual savings of approximately $20,000 to $40,000 per year.

The management has reacted very favorably to the recommendations given and are investigating the possibilities of implementing them.

Company # 17
SIC 33
Northwest Georgia

This firm was established in 1957 and has an employment of 85 persons. Principal products are aluminum extrusions used for windows, door frames, and electronic products. Aluminum is received in the form of billets approximately 8 inches in diameter and 24 inches in length. The billets are heated in a billet heater to 900^{o} and extruded by a 600 HP hydraulic press. The extruded lengths are cut to the required sizes and are finished by either annodizing or special painting. Painted pieces are sent to drying ovens for drying and curing. Of the raw stock processed, about 33% is scrap which is sent back to be converted into billets.

The total energy bill of the firm is approximately $250,000 a year, of which one half is for natural gas. The major natural gas consuming equipments are the billet heaters that heat by direct flame impingement, the paint drying ovens, and the heaters for hot water used in annodizing and painting operations. Electrical loads are the motors for hydraulic presses used in the extrusion process.

Although none of the gas consuming equipments are efficient, there is presently no economic incentive to improve the systems due to the low cost of natural gas. The plant is on a firm contract from the natural gas distributor and has had no curtailments of gas. Currently gas costs the firm approximately 52¢ per million BTU. Gas saved would come from the lowest cost section of the rate and the energy cost would be approximately 40¢ per million BTU. This low cost precludes many energy conservation initiatives due to low economic return. Unless gas price and/or availability changes, energy conservation ideas will not be implemented by the firm.

The majority of the electric loads are directly involved in some part of the production process and production has priority over demand control. Therefore, there is very little incentive for demand control.

The low cost of gas and the production oriented electric loads do not make the plant suitable on detailed case study, but specific technical options have been provided and can be implemented when interest improves.

4. Training of Area Office (Field) Personnel

A key component of this project is provision of technical assistance to firms in Georgia in the area of energy conservation. Georgia Tech maintains a staff of field engineers in seven offices throughout the state. This valuable resource is being used to promote the program, to assist project engineers in working to develop case studies, and to provide technical assistance to firms in the state. To ensure that the field representatives had the appropriate technical skills for providing technical assistance a three day intensive training course was designed and presented to 10 members of the field staff. The training course outline is shown in Appendix B.

The course was presented on May 5, 6, 7, 1976 at Georgia Tech. As can be seen from the course outline all aspects of industrial energy usage were treated and the participants were exposed to actual operating equipment at Georgia Tech. Direct experience was gained in key areas such as boiler combustion efficiency measurements. Instrumentation has been purchased and is being used by the area office representatives to conduct measurements in the field.

It is anticipated that the training course will serve as the basis for seminars and workshops to be conducted during the third quarter of the project.

5. Case Study, Evaluation, and Information Transfer Package Formats

In order to document activities of companies for transfer to other firms in Georgia or in other states, a detailed case study format has been developed. This format includes several major components and is outlined below. It is anticipated that this format will be standardized for use with all firms which participate in case studies.

Case Study Format

- .Type of Company
- .Employment
- .Production Characteristics
  - .Hours per day
  - .Days per week
  - .Number of shifts
- .Type and Yearly Production of Goods
  - .General description of products
  - .Yearly production rates
  - .Yearly sales
- .Description of Company Services
  - .Market area
- .Role of Energy in the Firm
  - .Kinds of energy used
  - .Amounts of energy used
  - .Energy per unit of production

- .Energy Consumption and Cost
  - .Quantities used
  - .Cost of energy
- .Prime Energy Consuming Systems in the Firm
  - .Line diagrams showing energy flow and use
- .Motivation for Energy Conservation
  - .Factors that were considered by firms
- .Current Energy Conservation Program
  - .Description of present status of company program
- .Conservation Potentials
  - .Potential conservation practices, procedures of processes are identified
  - .Recommendations for implementation
  - .Cost savings that can be derived
  - .General plan for conservation measures
- .Recommendations for a Continuing Energy Conservation Program Within the Company
  - .Short term action
  - .Long term action

As a part of the total case history documentation, video tape or slide-tape interviews with several companies will be included.

Evaluation Format

Evaluation efforts will be directed to determining the impact of the project in terms of (1) energy saved, (2) the effectiveness of the case study, technical assistance, and workshop/seminar program, and the basic mechanism of technical assistance as a method for encouraging industrial energy conservation.

Evaluation by participating companies of the effectiveness of the project serves as important feedback to both Georgia Tech and EDA. The elements of the case studies which appeared to be most valuable by the participating companies will be given primary emphasis in case study packaging. Components of the case studies which yielded little benefit to the companies should be documented only briefly. The evaluation effort will include detailed structured interviews with representatives of selected companies.

The evaluation of technical assistance activities to companies not participating in the case studies will be performed in two parts. The first part of this evaluation will be in the form of a printed brochure explaining the project, outlining the reasons for the importance of the energy conservation efforts, and soliciting the views and attitudes of companies concerning energy conservation measures or potentials in their plants. Companies will be asked to return a short survey postcard after answering questions to reflect these attitudes and indicating whether or not they desire technical assistance from Georgia Tech. The second part of the technical assistance evaluation will be an effort to determine the individual companies attitudes towards the technical assistance provided and a measure of the effectiveness of in house follow-up activities by the company, including estimated energy conserved. The results of this evaluation will be compared with the results of the workshop evaluation to determine the relative effectiveness of each.

An important component of the planned workshops is the evaluation of the effectiveness of these workshops. Current plans are for a two part evaluation, the first part occurring at the end of the workshop itself. This evaluation will help identify most pertinent areas covered, areas in which additional information is desired, and unnecessary data presented. The second phase of the evaluation will be held several months after the workshop. This mail-out evaluation form will attempt to identify the level of follow up activity as a result of the workshop. This evaluation will again attempt to identify areas in which additional information is desirable.

Project Technology Transfer Materials

A major element of the project is to develop materials for use in transferring the technology developed to other state agencies and other states. The intent is to fully document all materials developed in this project so that this experience can be transferred to other states, universities, industries, etc. for implementation.

The four elements of the total transfer package are:

- Documented In-Depth Case Histories
- Field Agent Training Program
- Evaluation Techniques for Energy Conservation Programs in Industry
- Industrial Energy Conservation Seminars and Workshops

The in-depth case histories will be fully documented and used as examples of what was done in various firms. The documentation will include: general facts and figures about the plant; previous energy conservation activities within the plant; engineering recommendations for potential energy conservation and cost savings from conservation; engineering recommendations on energy conservation by industrial category; and alternative actions on how to continue energy conservation efforts in companies. Videotape or slide-tape interviews with selected company personnel on energy conservation efforts within their company will also be a part of the documentation of case histories. As a part of the data collection procedure, various data forms are being examined to identify alternative methods of data acquisition for a plant.

Forms for in-depth case studies as well as technical assistance studies are currently being identified and evaluated. Documentation of the case histories has already begun during initial plant inspections and data collection activities.

The field agent training program has already been developed. It was used to train Engineering Experiment Station field staff involved in the project. The course outline, lecture notes, and handouts will all be contained in a field agent training program for the transfer package.

All evaluation materials will also be included in the transfer package as will be all lecture notes, agenda, etc. of the workshops which will be held in the third quarter of this project.

Workshops

Plans have been developed for conducting a series of workshops on Energy Conservation in specific topic areas starting October 1. The four tasks involved in the workshops are:

1. Developing workshop packages-handouts, workbooks, etc.
2. Workshop promotions
3. Conducting the workshops
4. Evaluating the workshops

Steps 1 and 2 will be carried out simultaneously. Workshop packages will be developed based on material used in previous workshops at Georgia Tech, material available from other sources, and information gleaned from case study work on this project. At the same time, plans for holding the workshops will be formalized and will include making arrangements for facilities, composing and printing a brochure announcement, and planning publicity.

As a result of information obtained during the first Advisory Committee meeting on the project it is planned to develop workshop materials for specific industries and to hold workshops on an industry by industry basis. Preliminary plans call for workshops aimed especially to the following industries: Textiles, Food Processing, Clay and Mining, Saw mill and Lumbering. One additional topic area which will transcend many industries is a special workshop on boiler operations.

Advisory Committee

A project Advisory Committee has been selected and has met with the project staff during this quarter. Appendix C shows a list of persons and organizations who were requested to serve on the committee. The committee members were selected to include representatives of industry, state government, federal government and trade associations. The committee was in agreement with the project plan and felt that good progress has been made. A major part of the Advisory Committee meeting was devoted to future directions for the project, especially with regard to workshop formats. The advisors felt that specific workshops limited to single industries were superior to general workshops. They felt that industry technical persons needed in-depth training in these workshops rather than general information. The advisors also addressed the problem of state level tax incentives for encouraging purchase and installation of energy conservation equipment. Mr. Glanton, a State Representative on the House Industry Committee and a member of the Advisory Committee is considering introduction of legislation that would address this issue.

6. Summary and Second Quarter Plans

During the first quarter of project 99-6-09359-1 progress toward all objectives was made. Seventeen companies have been visited and conservation plans are under development. A three day training program for Georgia Tech area office personnel was conducted to prepare those individuals for technical assistance activities. Case study formats and evaluation plans have been developed and will be expanded during the next period. An Advisory Committee meeting was held and significant input was received from advisors on workshop formats and on the need for legislative incentives to encourage energy conservation expenditures by Georgia companies.

In the second quarter, work with case study firms will continue and the rate of activity with technical assistance firms will increase. Information transfer packages will be further developed and specific company energy use data will be collected. Also during the next quarter, workshop and seminar planning will proceed with an anticipated date of October 1, 1976 for the first workshop. Evaluation procedures will be initiated with company interviews scheduled for August.

Appendix A

Company Energy Data

Form

PROPRIETARY

Date ____________________

EDA Project A-1644 (99-6-09539-1)

ENERGY CONSERVATION DATA SHEET

1. Company Name, Address ______________________________

   Company Contact, Position ______________________________

   Principle Products ____________________ Production ____________________

   ____________________ ____________________

   ____________________ ____________________

   Employment ____________________ Yearly Gross Sales ____________

   Interviewer ______________________________

   1a) Hours of operation, shifts, employment on shift ______ ______ ______

   ______ ______ ______

   ______ ______ ______

2. Cost Data (yearly)

   a) Electricity ________ c) Propane ________ e) Other ____________

   b) Natural Gas ________ d) Oil ____________

3. Major energy work underway or planned:

   ____

   ____

   ____

   ____

   ____

   ____

   ____

4. Action Requested ______________________________

   Next Action ______________________________

5. Electricity Consumption Data

a. Supplier ____________________

b. Rate Structure ____________________

c. Monthly Consumption and Cost

	Month	KWH	Actual Demand	Billing Demand	Cost ($)
1975	Jan.				
	Feb.				
	Mar.				
	Apr.				
	May				
	June				
	July				
	Aug.				
	Sept.				
	Oct.				
	Nov.				
	Dec.				
	TOTALS				
1976	Jan.				
	Feb.				
	Mar.				
	Apr.				
	May				
	June				
	July				
	Aug.				
	Sept.				
	Oct.				
	Nov.				
	Dec.				
	TOTALS				

6. Natural Gas Consumption Data

a. Supplier

b. Interruptible Gas__________ Firm Gas__________ Stored Gas__________

Attach copies of contracts noting any changes, ex. firm gas, demand minimums, etc.

c. Monthly Consumption and Costs

INTERRUPTIBLE

	Month	Cubic Feet	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

6. Continued

d. Monthly Consumption and Costs

FIRM

	Month	Cubic Feet	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

6. Continued

e. Monthly Consumption and Cost

STORED

	Month	Cubic Feet	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

7. Fuel Oil Consumption Data

a. No. 2 Oil ________ b. Supplier ________

c. No. 6 Oil ________ d. Supplier ________

e. Other ________ f. Supplier ________

g. Storage capacity: No. 2 ________

No. 6 ________

Other ________

h. Monthly consumption and costs

	Month	Gallons	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

8. Propane Consumption Data

a. Supplier ______________________

b. Storage Capacity ______________________

c. Monthly consumption and costs

	Month	Gallons	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

9. Other Forms of Fuel

a. Quantities & Types ______________________

b. BTU Content ______________________

c. Costs ______________________

d. Uses ______________________

10. Water Usage

a. Supplier ______________________

b. Rate Schedule (Attach Copies) ______________

c. Monthly Consumption and Costs

	Month	Cubic Feet	Cost
1975	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		
1976	Jan.		
	Feb.		
	Mar.		
	Apr.		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	TOTALS		

11. Processes to be Aware of in Interview (please note if process is used)

a. Multiple Metering

b. Boilers

   Boiler Capacity

c. Driers

   Drier Capacity

d. Ovens

   Oven Capacity

e. Hot Water

   Capacity

f. Refrigeration

   Refrigeration Tons

g. A/C Capacity

   Space Heating

h. Motors

   Horsepower

i. Turbines

   Turbine Power

j. Chilled Water

   Chilled Water Per Day

k. Type of Plant Lighting

   Plant Lighting Level

l. Other Major Energy Consuming Processes

m. Distribution of Energy

n. Air Compressors

o. Ventilation

p. Insulation

q. Humidification

r. Waste Heat Uses

12. Sketch of Major Energy Consuming Processes

13. What Heat Recovery Systems Have Been Installed?

____

____

____

14. How Much Energy Has Been Saved by Plant? (How?) ______________________________

____

____

____

15. Comments ______________________________

____

____

____

Appendix B

Extension Engineering Training

Course Outline

INDUSTRIAL ENERGY CONSERVATION WORKSHOP

MAY 5, 6, 7, 1976
ATLANTA, GEORGIA

CONDUCTED BY:

P/TAL LABORATORY
ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA

SCHEDULE

WEDNESDAY - MAY 5, 1976

A.M.

9:00 - 9:30	INTRODUCTION
9:30 - 11:00	COMBUSTION
11:00 - 12:00	TOUR - POWER PLANT

P.M.

1:00 - 2:00	ELECTRICAL DISTRIBUTION
2:00 - 3:00	ELECTRIC RATES GEORGIA POWER COMPANY
3:00 - 4:00	LIGHTING
4:00 - 6:00	ENERGY CONSERVATION CASE STUDY

THURSDAY - MAY 6, 1976

A.M.

8:00 - 10:00	TOUR - Baker Building, Electrical Engineering, Chemical Engineering, Civil Engineering
10:00 - 11:00	NATURAL GAS RATES AND SUPPLY ATLANTA GAS LIGHT COMPANY
11:00 - 12:00	HEAT RECOVERY

P.M.

1:00 - 2:00	STEAM
2:00 - 3:00	REFRIGERATION
3:00 - 4:00	SPACE HEATING, AIR CONDITIONING
4:00 - 6:00	ENERGY CONSERVATION CASE STUDY

FRIDAY, MAY 7, 1976

A.M.

8:00 - 9:00	COMBUSTION ANALYSIS
9:00 - 11:00	BOILER TESTING
11:00 - 12:00	REVIEW

P.M.

12:30 - 2:30	1644 PROGRAM PLANT SELECTION

COMBUSTION

I. Fundamental Process

1. Fuel

2. Air

3. Mixing

4. Products of Cumbustion

5. Caution
   Explosions, Insurance

II. Natural Gas

1. BTU Content

2. Theoretical Air

3. Actual Air

4. Draft

5. Burners - Natural Draft
   Bunsen
   - Drilled Port
   - Ribbon
   - Upshot
   - Inshot

6. Burners - Forced Draft

7. Combustion Train
   Pilots
   - Standing
   - Standing Safety
   - Electric

8. Control Valves
   Solenoid
   Diaphram
   Opening Speed.

9. Regulators
   Single
   Dual
   Typical Pressures
   Zero Pressure

COMBUSTION

I. Fundamental Process

1. Fuel

2. Air

3. Mixing

4. Products of Cumbustion

5. Caution
   Explosions, Insurance

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1. BTU Content

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   Bunsen
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   - Standing Safety
   - Electric

8. Control Valves
   Solenoid
   Diaphram
   Opening Speed.

9. Regulators
   Single
   Dual
   Typical Pressures
   Zero Pressure

10. Operating Control
    Thermostats
    - Room
    - Air
    - Water
    - Other

11. Limit Controls
    Purpose
    - High Temperature Limit
    - High Pressure Limit
    - Water-Low-High
    - Air Flow
    - Gas-High-Low

12. Jurisdictional Authorities
    - Local Codes
    - Utilities
    - A.G.A.
    - Factory Mutual Underwriters Laboratories State Insurance Program

13. Measurement
    Gas Meter
    - Low Pressure
    - Tin Case
    - Readings

    High Pressure
    - Readings
    - Multiplier

    Name Plate Data
    - Input
    - Output

    Orifice
    - Size
    - H_2O Reading

Appendix C

Advisory Committee Members

John Quarles
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Dalton, Georgia 30720

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Carpet and Rug Institute
Dalton, Georgia

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Atlanta, Georgia

Ms. Omi Walden
Office of Planning & Budget
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State of Georgia

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Atlanta, Georgia

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Cordele, Georgia 31015

A-16-4

Quarterly Progress Report #6

EDA Grant #99-6-09359-1

"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

by

J. L. Birchfield

October 1976

Table of Contents

1. Introduction

The goal of project #99-6-09359-1 is to reduce the impact of energy shortages and increased energy costs on employment and industrial expansion by creation and stimulation of industrial energy conservation programs. The project has several objectives including:

(1) Develop training materials for use by appropriate state agencies in encouraging industrial energy conservation,

(2) Develop in-depth case studies showing the economic benefit to be derived from company energy conservation programs,

(3) Provide technical assistance to industry in Georgia in energy conservation,

(4) Evaluate the impact of industrial energy conservation activities.

During the second quarter of the project further progress has been achieved toward those objectives. The project staff has continued to work with small to medium sized manufacturing companies to provide energy conservation assistance. During this period 21 additional firms have been contacted. Site visits and energy audits have been conducted and written reports describing conservation potentials and cost/benefits have been delivered or are in preparation. In-depth assistance to approximately 15 companies who may qualify as case-study firms is continuing. Development of training materials and a methodology information transfer package is continuing and conservation opportunities are being continually added as new manufacturing companies are audited. Preparation of a slide/tape program which includes interviews with plant managers, who have been involved in this project and which will be included in the transfer package is continuing with four interviews having taken place to date.

During the last period this project was the subject of a feature article in the Sunday mazagine supplement to the Atlanta Journal/ Constitution newspaper. The article, which describes conservation efforts at Georgia Tech, a copy of which is attached, included interviews with company personnel in three of the plants with which the project staff is working. Also during the last period, Rep. Tom Glanton, a member of the project advisory committee initiated action to provide tax credits to businesses that purchase and install energy conservation equipment. Legislation is planned for introduction in the 1977 Georgia legislative session.

Additionally, during this period, this project has resulted in a proposal from Georgia Tech to the State of Georgia for creation of an Energy Extension Service program to be administered through the Engineering Experiment Station. This proposal is consistent with plans of the State's Office of Energy Resources (formerly the State Energy Office) and has the support of that office.

Case Study Activities

During this period in-depth assistance was provided to 15 companies who may be used as case study firms. Actities with these 15 firms will continue during the remainder of the project period and the 6-8 firms which are most advanced in implementing recommended conservation projects will be selected as case study examples. Companies in

SIC	20	(Food)
SIC	22	(Textiles)
SIC	32	(Mining, Ceramics)
SIC	33	(Metals)

are anticipated to be included in the final case study documentation.

In activities with these companies the project staff have conducted energy audits, have analyzed these data to determine energy conservation potentials and specific projects that are economically feasible, and have made recommendations to company personnel to initiate activity. These steps are being documented, along with data and information describing each company, and are being described according to the case study format described in the Fifth Quarterly Progress Report.

These case studies will become part of the methodology transfer package which meets objective (1) above.

Technical Assistance Activities

Twenty-one companies have been visited and have been provided technical assistance during this period. These firms include textile mills, poultry processing plants, apparel plants, paper products plants, and metal fabricating firms. Audits have been performed, site visits have been conducted, and written recommendations have been prepared and forwarded to most firms.

On September 29 a paper entitled "Heat Recovery in Carpet Processing" was presented at the Carpet and Rug Institute Technical Conference. This conference was held in Gainesville, Georgia and was attended by technical representatives from approximately 60 firms.

Five energy conservation workshops have been planned and scheduled. These are:

	Subject	Date	Place
1.	Energy Conservation Systems for the Textile Processing Industry	19 October 1976	Dalton, Georgia
2.	Energy Conservation/Light Manufacturing Industry	18 November 1976	Atlanta, Georgia
3.	Energy Conservation/Apparel Industry	9 December 1976*	Carrollton, Georgia

	Subject	Date	Place
4.	Energy Conservation/Stone, Clay, and Primary Metals	11 January 1977*	Macon, Georgia
5.	Energy Conservation/ Poultry Processing	25 January 1977*	Gainesville, Georgia

These workshops are planned to be industry specific with examples, cases studied, and audit procedures planned for the targeted industry. The workshop training materials will be included in the methodology transfer package described below.

Training Materials/Methodology Transfer Materials

Preparation of a complete set of materials describing all activities under this grant proceeded during this period. These materials are being prepared in a "kit" format so that they can be used to initiate similar energy conservation projects in other states. Documentation of the field agent training course, seminar and workshop course materials, case studies and technical assistance briefs, and preparation of a slide/tape presentation are continuing under this effort.

The slide/tape presentation is considered to be a key element of this transfer package. The program is designed to have energy conservation opportunities communicated by plant personnel to audiences. Interviews with appropriate plant personnel have been scheduled and two have been completed.

*Tentative dates

Other Activities

A project advisory committee meeting was held on 15 September 1975. The second quarter project activities were described by the staff and third quarter plans were discussed. Representative Tom Glanton, a member of the Industry Committee, Georgia House of Representatives informed the committee of his plans to initiate legislation that would allow tax exemptions for new equipment purchased to specifically conserve energy.

The project was the subject of a feature article in the Atlanta Journal/Constitution magazine supplement on 19 September 1976. A copy of this article has been forwarded under separate cover.

The project has resulted in a proposal by Georgia Tech to the State of Georgia to establish an Energy Extension Service. This service would be state funded and would employ approximately 20 full-time professionals in work similar to that funded under Grant #99-6-09359-1. The proposal has been presented to the State Office of Energy Resources and meets with the overall plans of that office. The proposal will be considered for funding in the 1977 Legislative Session. The proposal has the support of the Georgia Poultry Federation, the Georgia Business and Industry Association, and the House of Representatives Industry Committee.

Future Plans

During the next period work to achieve the major project objectives will continue. Three workshops will be held and technical assistance efforts will continue. Preparation of the transfer package materials will continue with emphasis being placed on completion of the slide/tape interview package component.

A-1614

Quarterly Progress Report #7

EDA Grant #99-6-09359-1

"A Project to Reduce the Impact of Energy Shortages and Cost Increases on Industrial Production in the Southeast"

by

J. L. Birchfield

G. C. Curtis

G. Soora

R. G. Pearl

January 1977

Table of Contents

1. Introduction

The goal of project #99-6-09359-1 is to reduce the impact of energy shortages and increased energy costs on employment and industrial expansion by creation and stimulation of industrial energy conservation programs. The project has several objectives:

(1) to develop training materials for use by appropriate state agencies in encouraging industrial energy conservation,

(2) to develop in-depth case studies showing the economic benefit to be derived from company energy conservation programs,

(3) to provide technical assistance to industry in Georgia in energy conservation,

(4) and to evaluate the impact of industrial energy conservation activities.

During the seventh quarter of the project further progress has been achieved toward these objectives. The project staff has continued to work with small to medium sized manufacturing companies to provide energy conservation assistance. Nine additional firms were contacted. Plant analyses with recommended energy and cost savings methods have been forwarded to company contacts. In-depth technical assistance to the 15 selected firms has continued. Preparation of a slide-tape presentation including interviews with several plant managers has proceeded and will be completed early in the eighth quarter. Preparation of legislation for state tax incentives for industrial conservation is proceeding with Rep. Glanton and will be introduced during the 1977 legislative session.

A seminar was presented in western Georgia for the House Industry Committee and approximately 65 bankers and businessmen. This seminar is to be presented again on January 26, 1977 to the Appropriations Committees and Industry Committees of both houses of the Georgia legislature.

Specific progress in each project area is described below.

Case Study Activities

Activities during this period have been a combination of in-depth case studies and technical assistance given to 15 selected companies. The companies fall into the following SIC classifications:

SIC 20 Food and Kindred Products

SIC 22 Textile Mill Products

SIC 32 Stone and Clay Products

SIC 33 Primary Metal Industries

Project staff members have visited the various plants and facilities and have conducted energy audits. The different processes and pieces of equipment were analyzed individually to find more energy efficient methods of operation. A systems approach audit was implemented in each plant to study potential recycling of energy given off in waste streams at different locations within the plant. Written recommendations were given to the plant managers of potential economically justifiable energy saving projects, based on the analysis of the data collected.

The recommendations given have been well received on the whole and modifications for energy savings are underway. In a number of cases, the suggestions that did not involve a major capitol investment have been implemented. These methods include boiler tuning, stopping steam leaks, repairing steam traps, turning off equipment when not in use, replacing damaged thermostats, and other housekeeping and maintenance operations.

Although many companies still have our recommendations under consideration, the projects involving capital investment are in various stages of implementation ranging from soliciting bids to actual installation of hardware. One textile manufacturer is installing a low temperature, low pressure "economizer" to the boiler which will preheat boiler make-up water. They are also installing a new 1-1/2" pipeline parallel to their existing 1-1/2" pipeline for boiler make-up water to reduce the excessive pressure drop in the lines. A manufacturer of sanitary ware has requested proposals to install a heat recovery system on his tunnel kiln. In the primary metals industry an aluminum extruding firm is modifying the burners in its smelting furnace to increase the firing efficiency. They have also started instrumentation of the various processes to monitor energy usage.

The entire process of energy conservation requires a considerable amount of time from the conception of the energy-saving idea to actual installation or equipment modification. Due to the time element involved, it may not be possible to actually monitor the operation of all these projects before the close of the contract.

Technical Assistance Activities

During this quarter nine new plants were visited and energy audits performed. Technical assistance in the form of written recommendations of potential energy saving modifications were given to firms. Follow-on work for the companies visited during the first two quarters was carried out by responding to requests for additional information or by solving specific problems. A brief description of each operation, the recommendations given, and the current status of activity in the nine new companies is given below.

Company 1

This firm, located in northwest Georgia, is principally involved in carpet dyeing. It has a total of 105 employees and produces around 1.7 million pounds of dyed carpet per month. The annual energy bill is $100,000 for electricity, $240,000 for natural gas, $100,000 for fuel oil. The plant was visited by the project staff. Combustion efficiency of the boilers was found to be around 82%. It was recommended that timers be installed for the space heating and cooling of the plant. It was also recommended that better controls be installed on the steam input to the dye beck.

Company 2

Located in southeast Georgia, this firm is a manufacturer of active ingredients used for pharmaceuticals. They employ 200 people and have an energy bill of over a million dollars of which 55% is for electricity and 42% is for natural gas. The remaining energy is supplied by fuel oil. Assistance has been given in improving boiler combustion efficiency, modifying the lighting system, and changing the air conditioning system.

Company 3

This firm is a manufacturer of sewer pipe, fire brick, and other vitreous products. They have total employment of 61 persons. Their primary fuel is natural gas. Three potential energy conserving projects were identified: 1) use of preheated air for the drying ovens, 2) use of preheated air in the kilns, and 3) recovery of heat from bricks during the cooling process.

Company 4

This firm is a manufacturer of knit underwear and knit cloth, employing a total of 616 people. Their major energy consuming pieces of equipment are the air conditioning system and the boiler. Assistance has been given to improve boiler efficiency and to modify the air conditioning system for better operation.

Company 5

This firm located in northwest Georgia is a manufacturer of formed slips and plastic bags. The major fuels used are natural gas and propane. The energy consuming equipment in the plant is the air conditioning unit and the paint drying oven. It was recommended that paint drying ovens be isolated and insulated from the air conditioning area since the air conditioner was being overloaded from the oven heat loss. Other recommendations were given to reduce the load on the air conditioner.

Company 6

This firm is located in southeast Georgia and manufactures gypsum board and gypsum products. The total employment of this firm is 121 persons. The plant has been visited by project staff. Energy data is being gathered.

Company 7

This firm is located in northwest Georgia and is a manufacturer of tufted carpets. The employment is 210 persons. This company has been contacted and visited by project staff and data is being collected. Final recommendations are being prepared.

Company 8

This firm is located in southeast Georgia and manufactures wire-bound boxes, paper overlaid veneer and expendable pallets. The plant has an employment of 300 persons. The major type of energy used is electricity and the annual bill runs over $100,000. Natural gas supplies the remaining fuel needs and the annual bill runs close to $2,000. It has been recommended that the firm investigate the economic feasibility of an energy management system incorporating demand control. It has also been suggested that in certain sections of the plant it might be economically justifiable to use belt conveyors instead of the present pneumatic conveyors. Some modification of the loading and separation equipment for the wood chip transportation system has been suggested which would require less energy.

Company 9

This firm is located in southwest Georgia and manufactures butterfly valves. The employment of the plant is 125 persons. The plant has been visited and the energy audit is in progress. Written recommendations will be sent when data compilation is complete.

Training Materials/Methodology Transfer Materials

Transfer package development efforts during the quarter centered around the design of materials to be used in energy conservation workshops. These materials include workshop agendas, announcements, planning schedules, visual aid materials, an audio-visual presentation on management decision-making to conserve energy, and a complete transcript of an actual workshop.

The largest single effort of those listed, has been the development of the audio-visual presentation on management decision-making. Six decision-makers in industry have been interviewed extensively as to the criteria they use in making decisions relative to reducing plant energy consumption. Their comments have been transcribed and edited and are being incorporated into a script developed for the presentation. The complete text of these interviews will also be included in the final report.

The audio-visual package will be designed for a dual purpose; it can be used as the introduction to the management section of the workshop, and it can be used in a stand-alone mode for presentations in management meetings and conferences.

Interviews to date have been with individuals in the poultry, lumber, textile, paper products, and primary metals industries. Individuals included plant managers, corporate officers, and plant engineers. Return on investment has been the major factor in the energy conservation decision-making process. Capital expenditure plans for energy conservation must compete with capital expenditures designed to increase production or to reduce costs in other ways.

Many of the interviewees confirmed that unique energy conservation problems and solutions exist for each industry, and often each plant. They minimized the value of "general" industrial energy conservation information and praised the development of case studies for specific processes in a given industry.

Interviewees also responded to general questions regarding methods they would normally use to conserve energy. Most responses indicated a common reliance upon plant engineers, equipment vendors, and university faculty for information on energy conservation possibilities They favored workshops for the introduction of energy conservation concepts, but found that individual engineering efforts were necessary before significant amounts of energy could be saved.

During the remainder of the project the organization and management section of the transfer package will be completed. This section will describe methods and procedures recommended for the establishment and operation of a state-wide energy extension service, and will be based upon the experience gained during this project.

The first of the Energy Conservation Workshops was held at Dalton, Georgia on October 19, 1976 for the Textile Processing Industry. The workshop agenda and registration form was sent to textile manufacturers in the southeast region. There was a total of forty-five registrants representing a wide size range of companies and manufactured products. A copy of the announcement brochure is included below in Table I.

At the conclusion of the program the participants were requested to evaluate the workshop. A copy of the form used is shown in Table II. Twenty-eight of those present participated in the evaluation and a summary of their opinion is shown in Table III.

Table I

Textile Workshop Agenda

Time	Topic
8:30	Introduction
9:00	Accounting for Energy
	What to Measure Where to Measure How to Measure How to Analyse
10:30	Energy Waste Reduction
	Dyeing Dryers Boilers
12:00	Lunch
1:00	Energy Recovery
	Application Boilers Dryers Wet Processes
3:15	Open Discussion
3:45	Questions
4:15	Suggestions for Research
5:00	Adjourn

TABLE II

SAMPLE EVALUATION FORM

Energy Conservation Systems in the Textile Processing Industry

What was your overall impression of the workshop?

What part of the workshop was most valuable?

What part was least valuable?

What are the estimated annual energy costs for your plant?

Natural gas__________________________

Electricity__________________________

Fuel Oil_____________________________

What percentage of this energy do you feel your plant can save?

Natural gas__________________________

Electricity__________________________

Fuel Oil_____________________________

Say that management at your plant is considering a capital investment for equipment to reduce energy consumption.

What payback must this equipment have?______________________

What return on investment must it have?_____________________

What major energy conservation efforts have you already made?

What major energy conservation efforts are you considering?

Comments:

Limited technical assistance in energy conservation in individual plants is available. For information, send company name, major products, and estimated yearly consumption to: Ron Pearl, Georgia Tech Engineering Experiment Station, Atlanta, Georgia 30332.

TABLE III

WORKSHOP EVALUATION

Energy Conservation Systems

for the

Textile Processing Industry

Summary of Evaluation

Overall Impression	Number of Persons
Poor	1
Fair	4
Average	4
Good	11
Very Good	8
Topic Most Valuable	**Number of Persons**
Boiler	14
Energy Recovery	9
Dye Beck	7
Tenter Frame	5
Dryer Waste Reduction	5
Pre-Drying	3
Energy Accounting	2
Dyeing	2
Floor Discussion	1
Topic Not Applicable	**Number of Persons**
Beck Drying	2
Dye Becks	2
Tenter Frames	2
Production Methods	1

Other Activities

The first of the Energy Conservation Workshops was held at Dalton, Georgia on October 19, 1976 for the Textile Processing Industry. The planning for the other Energy Conservation Workshops is complete. The scheduled topics, dates, and locations are as follows:

	Subject	Date	Location
1.	Energy Conservation/Apparel Industry	1/25/77	Carrollton, Georgia
2.	Energy Conservation/Stone & Clay	1/27/77	Macon, Georgia
3.	Energy Conservation/ Manufacturing Industries	1/31/77	Savannah, Georgia
4.	Energy Conservation/ Manufacturing Industries	2/3/77	Atlanta, Georgia

Attached are copies of registration forms for the meeting which include the program outline.

Mr. Grant Curtis, Senior Research Engineer, of our staff, has been extended an invitation to address the monthly meeting of American Institute of Plant Engineers, Georgia Chapter, on March 14, 1977 to present a program on industrial energy conservation and on the work we are engaged in under this program.

One of the desired objectives of Georgia Tech's involvement in this program is the development of energy conservation assistance programs in other areas. One such program is under way in the public school systems. There are over 200 city-county public school districts in the state of Georgia. Each unit contains from eight to over 100 schools. Energy conservation programs have been developed and implemented in two counties and three others are scheduled.

Typically, conservation efforts of this type have resulted in a 20 to 40% energy reduction with a program cost return of less than 12 months.

Future Activities

During the next period four technical workshops and one seminar for legislators will be presented as discussed above. Also during the next period the preparation for final report material will be completed including:

(1) Transfer package (methodology)

(2) Slide tape interviews

(3) Case study materials

(4) Technical assistance materials

Additionally, an evaluation effort of case study and technical assistance work will be conducted by EES area office personnel. Residual assistance requests will be met and all cases of assistance under this project will close.

Space Heating/Cooling

Company ______________________

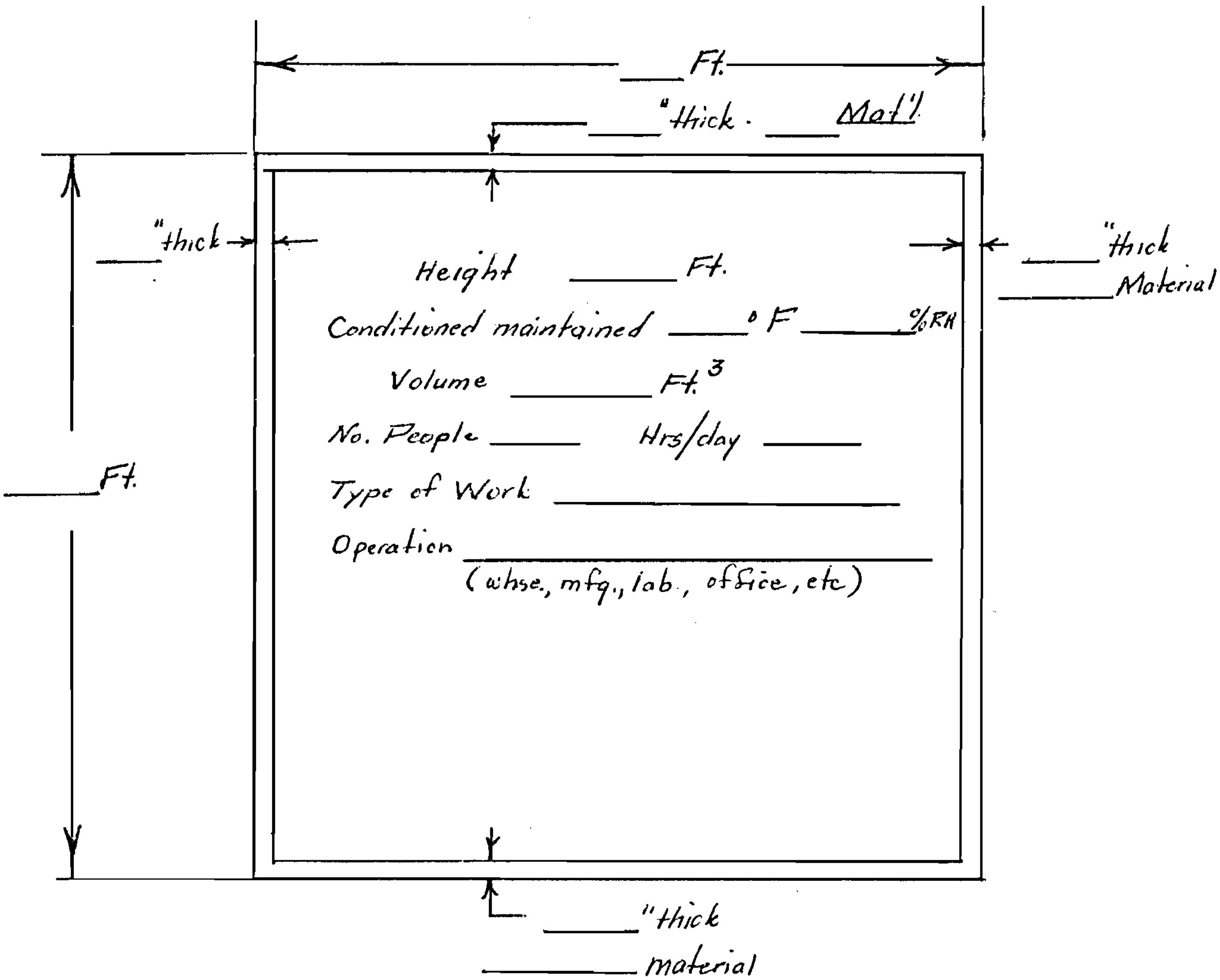
S/C ________

Location ______________________

Contact ______________________

Date ____________

by ________



1. Locate doors, indicate size and how often opened.

   3'x 7' (6 x/day)

2. Indicate atmosphere outside each wall

   weather
   Air Cond 70°F, 80% RH

3. Ventilation ______ CFM Exh. ______ CFM Supply

4. ______ Tons A/C ______ °F ______ % RH

5. Indicate orientation by arrow

Conditions:

	Summer		Winter
Room	____ °Fdb	____ % RH	____ °Fdb
Outside	____ °Fdb	____ % RH	____ °Fdb

Equipment

	Heating	Cooling
Type	________	________
Rating	________ Btu/hr	________ tons
Manufacturer	________	________
Year	19 ____	19 ____

Condenser (manuf'r, year) ________________, 19 ____

Material, tubes ________________

jacket ________________

Heat transfer area ________ Ft²

Expansion Coil (manuf'r. year) ________________, 19 ____

Material, tubes ________________

" jacket ________________

Heat transfer area ________ Ft²

Heat Exchangers/Condeners

Company ____________
SIC ______
Location ____________
Contact ____________
Date ______
by ____________

Dimensions:
_____ ft. OA Length _____ ft OA Width

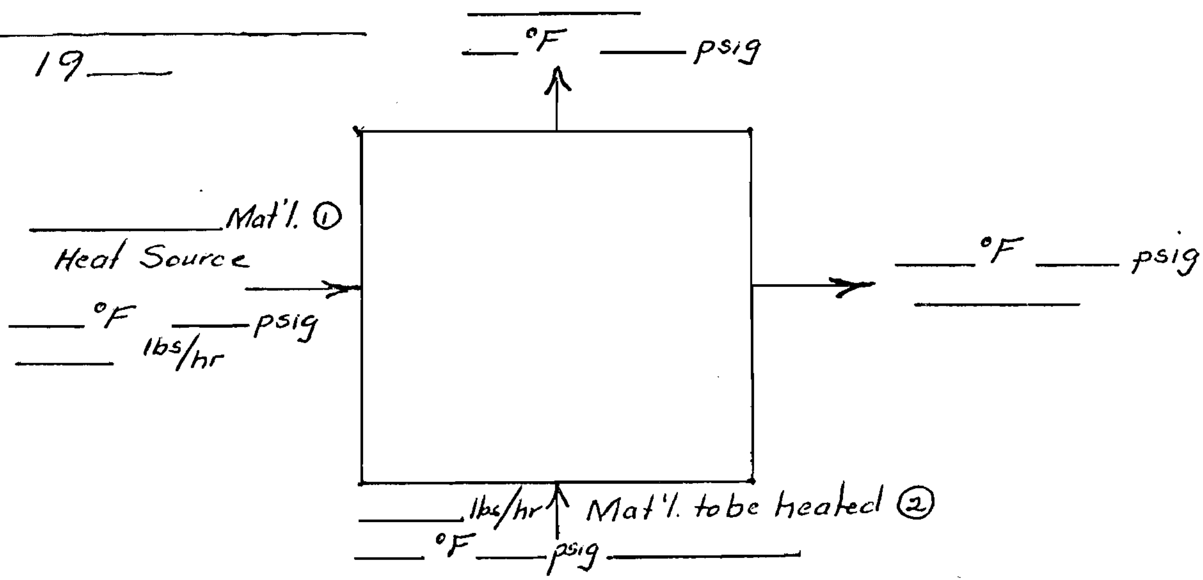
Mat'l. ① _____ in. dia. inlet, _____ in. dia outlet

Mat'l. ② _____ in dia. inlet _____ in. dia. outlet

Type: Mat'ls. _____ tubes, _____ jacket

Heat Transfer Area _____ ft^2

Manuf'r. ____________
year 19___



Mat'l. ① C_p ___ $\frac{Btu}{lb\,°F}$, h_{in} = ___ $\frac{Btu}{lb}$ h_{out} = ___ $\frac{Btu}{lb}$

Mat'l. ② C_p ___ $\frac{Btu}{lb\,°F}$, h_{in} = ___ $\frac{Btu}{lb}$ h_{out} = ___ $\frac{Btu}{lb}$

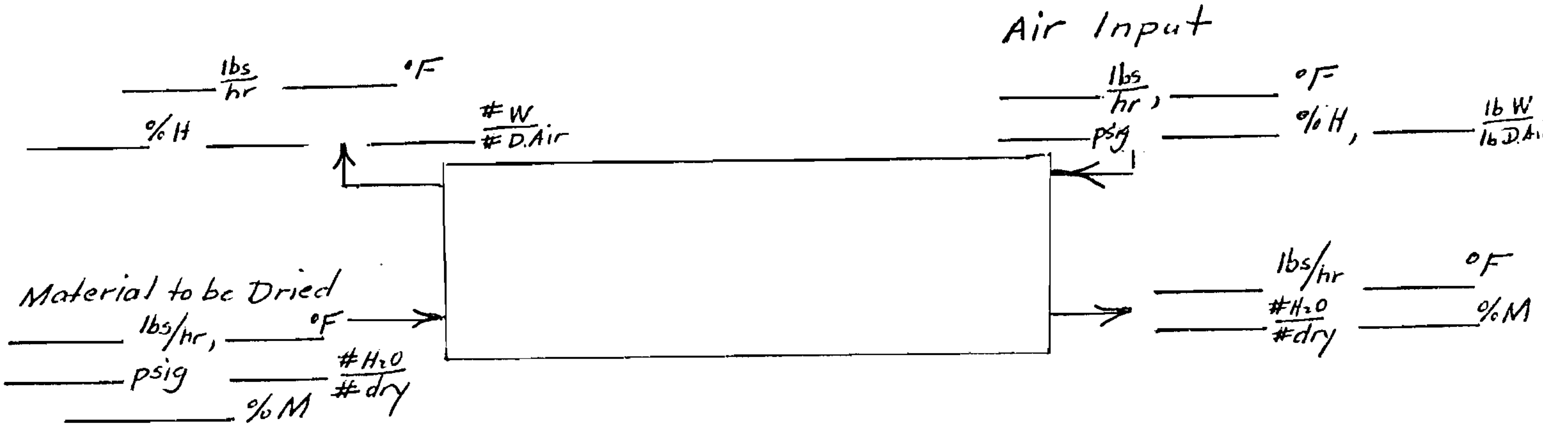
Heat Balance Datum: °F (use low temperature stream)

$$\dot{q} = \dot{w} h = \dot{w} C_p (t - t_d)$$

D/HA

Dryer - Hot Air

Company ______________________
SIC __________
Location ______________________
Contact ______________________
Date __________
by ________________



Mat'l. to be Dried: C_p =

Water evap'd =

Est'd. Evap. Temp. ___ °F

Air: C_p

Lat. Ht. ____ Btu/lb.

Heat Balance: Datum: ___ °F (use low temperature stream)

Dimensions: _____ ft. long _____ ft. high _____ ft. wide
Air ____ in. x ____ in. inlet, ____ in. x ____ in outlet
Type ______________________
Mat'l. _____ walls, ___ in. _____ insulation
Rating _____ Btu/hr _____ lbs Water/hr
Manufacturer. ______________________, 19___

SURVEY

rify construction where weight is to be supported

LLS — Note exposure and shading of the walls.

Light – 40 lb./sq. ft. – 8" light weight aggregate concrete block or frame with 4" brick facing.
Medium – 60 lb./sq. ft. – 4" concrete block with 4" brick facing
Heavy – 100 lb./sq. ft. – 8" brick
Insulation thickness – (0) (1) (2) (3) (4) inches
Insulation R-value – (0) (4) (7) (11) (13)

NDOWS — Note type of windows and shading

RTITIONS — To unconditioned space
To kitchen or boiler room
Insulation thickness (0) (1) (2) inches
Insulation R-value (0) (4) (7)

OF NSTRUCTION — Light roof (preformed slab)
Medium roof (4" concrete)
Hung ceiling (yes) (no)
Insulation thickness (0) (2) (4) (6) inches
Insulation R-values (0) (7) (13) (19)
Ceiling Ventilation (yes) (no)

ILING — Conditioned space above (yes) (no)

OOR — Conditioned space below (yes) (no)
Slab floor on ground (yes) (no)

HTS — Type Watts (See Table 6)

PLIANCES — (See Table 6)

HAUST FANS — (Yes) (No) ________ cfm

OPLE — Number

TDOOR AIR — See notes with Table 8.

WER SUPPLY — ________ volts ________ phase ________ cycle
Panel ________ feet from unit
Main service capacity ________ amps

TER SERVICE — Connection ________ ft. from unit
Size ________ inches
Water pressure ________
New service, new meter
Pressure reducing valve

NDENSER TER AND/OR NDENSATE AIN — Distance from unit ________ ft.
Low enough for gravity flow of condensate
New drain or condensate pump required

S SERVICE — Distance from unit ________ ft.
New service, new meter

R-COOLED NDENSER — Special construction required?
Distance from unit ________ ft.
Height above or below unit ________ ft.

ATING — Steam pressure ________ psig
Hot water temperature ________ F
Capacity available ________ (Btuh) (lbs. steam) (gpm)
Connection ________ ft. from unit
Connection size ________ inches

DESIGN

Size of Space ________
Floor Area ________ Sq. Ft.
Ceiling Height ________ Ft.
Room Volume ________ Cu. Ft.

CONDITIONS	SUMMER	WINTER
Room	____ Fdb ____ % Rh	____ Fdb
Outdoor	____ Fdb ____ Fwb	____ Fdb

GENERAL NOTES

1. Record information essential to the cooling and heating estimates, air distribution system and equipment selection, location and installation. Sketch floor plan on page 1.
2. Table factors are based on 75 F room temperature. Factors include 5% for fan heat and are based on 12-hour equipment operation.
3. Insert factors from tables in cooling estimate. Quantity x Factor is equal to cooling load.
4. This form can be used for applications where the peak loads occur during the normal summer daytime hours. For other applicantions use form E-20.
5. This form should not be used for locations over 2000 ft. above sea level.

TABLE 1 – WINDOW FACTORS

Exposure	Base Factor Latitude 30°	40°	50°	Shading Multipliers Single Glazing Bare	Inside Shades	Outside Awnings	Double Glazing Bare	Inside Shades	Outside Awnings
N	40	36	36	1.0	.86	.75	.67	.53	.42
NE NW	55	59	61	1.0	.75	.56	.76	.53	.34
E W	86	90	91	1.0	.68	.45	.81	.55	.30
SE SW	96	96	94	1.0	.67	.44	.80	.53	.30
S	85	80	75	1.0	.69	.48	.80	.54	.31

1. Consider show windows as an ordinary window if there is no partition and use the above factors. If there is a partition, use a factor of 20 and the area of the partition.
2. Factors based on 95 F outdoor design temperature. For 100 F design add 6 to the base factor. For 105, add 12 and for 110, add 17. Deduct 6 for 90 F.
3. Overall window factor = Base factor x shading multiplier.
4. Factors include both solar and transmission loads.

TABLE 2 – WALL FACTORS

Construction	Base Factor Exposure N	NE S NW	E SE SW W	Insulation Factor R4	R7	R11	R13
Light 40#, U= .34	4	8	10	.42	.30	.21	.18
Medium 60#, U= .39	5	9	12	.39	.27	.19	.16
Heavy 100#, U= .45	5	11	14	.36	.24	.17	.15
Partition							
Unconditioned space adjacent		6		.43	.30		
Kitchen or boiler room adjacent		11		43	.30		

1. Consider shaded walls as facing North.
2. Factors based on 95 F outdoor design temperature. For each 5 F higher design temperature add 2 to base factor.
3. Overall wall factor = Base factor x insulation factor.
4. R-4 approximates 1" insulation, R-7 approximates 2", R-11 approximates 3", R-13 approximates 4".

TABLE 3 – ROOF FACTORS

Construction	Base Factor	Insulation Factor			
		R7	R11	R13	R19
ight No Ceiling 10#, U= .20	8	.41	.31	.28	.21
ight Ceiling 10#, U= .13	5	.53	.41	.37	.29
edium No Ceiling 40#, U= .51	24	.22	.15	.13	.09
edium Ceiling 40#, U= .21	10	.41	.30	.27	.20

Factors based on 95 F outdoor design temperature. For each 5 F higher design temperature add 1 to base factor for light roofs, and medium roofs with ceiling. Add 3 to medium roof with no ceiling.

Overall roof factor - Base factor x insulation factor.

If ceiling space is ventilated by a fan, multiply factor by .75.

R-7 approximates 2" insulation, R-11 approximates 3", R-13 approximates 4", R-19 approximates 6".

TABLE 4 – CEILING FACTORS

Roof Above	See Table 3
Conditioned Space Above	0
Unconditioned Space Above	4

TABLE 5 – FLOOR FACTORS

	Base Factor	Insulation Factor		
		R7	R11	R13
nconditioned space Below	5	.3	.21	.19
tchen or Boiler Room Below	15	.3	.21	.19
ab Floor	0			
onditioned Space Below	0			

-7 approximates 2" insulation, R-11 approximates 3" R-13. proximates 4".

TABLE 6 – ELECTRICAL AND APPLIANCE LOAD

		Quantity	X Factor*	= Btuh
ncandescent lights (Per watt)			3.6	
uorescent Lights (Per tube watt)			4.5	
achines	Per KW		3600	
	Per HP		2900	
auty Parlors (per operator)			2000	
s Burners (Each)			6000	
ass Coffee makers (Each)			900	
offee Urn per Gallon Capacity			1400	
eam Tables — Electric (per sq. ft. surface)			550	
eam Tables — Gas (per sq. ft. surface)			1300	
her appliances				
*Factor includes 5% Fan Heat			Total =	

Factors for appliances with properly designed hoods may be reduced 50%.

Adjust ratings of machines that are not fully loaded or do not run continuously.

Appliance factors are not maximum values but are adjusted for average use. For appliances not listed, use 50% of manufacturer's rating.

TABLE 7 – PEOPLE LOAD FACTORS

Typical Application	Factor Total*	Factor Latent	Typical Application	Factor Total*	Factor Latent
heater, Auditoriums	360	120	Banks, Library, Museums	515	245
igh School	410	160	Restaurant	565	270
ffices, Hotels, Apts., Colleges	465	205	Factory, Light work	765	455
ept., Retail or Variety Store	465	205	Dance Hall	865	525
			Factory, Fairly Heavy Work	1020	620
rug Store, Beauty Parlor, Barber Shop	515	245	Factory, Heavy Work	1475	925

*Includes 5% Fan Heat

TABLE 8 – OUTDOOR AIR FACTORS

Room Conditions	Total: Outdoor Wet Bulb 65	70	75	78	80	Sensible: Outdoor Dry Bulb	Factor
75 F, 50%	8	26	46	59	69	85	11
						95	22
75 %, 55%	3	21	41	55	64	105	32
						115	43
75 F, 60%	–	17	37	50	60		

In determining the outdoor air quantity for calculating the outdoor air load be guided as follows:

1. Outdoor air through the unit.
   a) No exhaust fans, use value from Table 9.
   b) Exhaust fans, use exhaust fan air quantity or value from Table 9, whichever is greater. In the absence of exhaust air information, base air quantity for 20 air changes per hour for toilet room and 10 air changes for other ventilated rooms.
2. No outdoor air through the unit.
   a) No exhaust fans, use 7 cfm per person.
   b) Exhaust fans, use exhaust air quantity.

COOLING ESTIMATE

ITEM	Exposure	Quantity	X Factor	= BTUH
WINDOWS (Table 1)		sq ft		
		sq ft		
		sq ft		
		sq ft		
WALLS (Table 2)		sq ft		
		sq ft		
		sq ft		
		sq ft		
Partitions (Table 2)		sq ft		
Roof (Table 3)		sq ft		
Ceiling (Table 4)		sq ft		
Floor (Table 5)		sq ft		
Electrical and Appliances (Table 6)				
People (Total) (Table 7)		persons		
Room Total Heat (RTH)				
Outdoor Air (Total) (Table 8)		Cfm		
Grand Total Heat (GTH)				

1. Room Sensible Heat (RSH) = (RTH) - People X Latent Factor (Table 7)*
2. Sensible Heat Factor (SHF) = RSH/RTH
3. Total Sensible Heat (TSH) = RSH + CFM** X outdoor air factor (sensible) (Table 8)

* Also deduct 50% of the load of moisture producing appliances.
** Cfm is outdoor air quantity.

TABLE 9 – DESIGN DATA, PEOPLE AND VENTILATION

Application	Room Conditions	SHF	ADP °F	Occupancy Sq ft/Person	Outdoor Air Cfm/Person	Supply Air Factor
Private Offices	75 F, 50%	.9-.95	54	125	30	.059
General Offices	75 F, 50%	.9-.95	54	80	15	.059
Hotel Rooms	75 F, 50%	.9-.95	54	150	30	.059
Apartments	75 F, 50%	.9-.95	54	175	20	.059
Museums, Libraries, Banks	75 F, 50%	.85-.9	52	60	10	.054
Dept. Stores, Upper Floors	75 F, 50%	.85-.9	52	60	7½	.054
Dept. Stores, Main Floors	75 F, 50%	.8-.85	52	25	7½	.054
Barber Shops & Beauty Shops	75 F, 50%	.8-.85	52	40	15	.054
Variety Stores	75 F, 50%	.8-.85	52	40	10	.054
Dept. Store Basements, Dime Stores, Drug Stores	75 F, 50%	.75-.8	52	30	10	.054
Classrooms	75 F, 50%	.75-.8	52	25	7½	.054
Auditoriums	75 F, 55%	.70-.75	52	10	7½	.054
Restaurants	75 F, 60%	.65	52	15	15	.054
Theaters	75 F, 60%	.65	52	10	7½	.054

1. Occupancy and outdoor air values are suggested values to use if actual figures are not available. See also local codes which may govern.
2. SHF is average room sensible heat factors for application.
3. ADP is average apparatus dewpoint temperature for application.

TABLE 10 – COIL ENTERING AIR TEMPERATURES

Entering Wet Bulb

ROOM CONDITIONS	Outdoor Wet Bulb 65				70			75			78			80		
	PERCENT OUTDOOR AIR THROUGH UNIT (NOTE 2)															
	0	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
75F, 50%	62.6	62.8	63.1	63.3	63.5	64.4	65.3	64.0	65.4	66.7	64.4	66.2	67.8	64.7	66.7	68.6
75F, 55%	64.0	64.1	64.2	64.3	64.6	65.2	65.9	65.2	66.4	67.6	65.5	67.2	68.7	65.9	67.7	69.4
75F, 60%	65.3	----	----	----	65.8	66.3	66.8	66.4	67.4	68.4	66.8	68.1	69.4	67.0	68.7	70.3

Entering Dry Bulb

	Outdoor Dry Bulb 85				95			100			105			115		
	PERCENT OUTDOOR AIR THROUGH UNIT (NOTE 2)															
75 F.	0	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
Any RH.	75	76	77	78	77	79	81	77.5	80	82.5	78	81	84	79	83	87

1. For outdoor air percentages from 30% to 50%, it is permissible to extrapolate.
2. % outdoor air = Outdoor air cfm x 100 / Total Cfm = %

EQUIPMENT SELECTION DATA

RSH X	SUPPLY AIR FACTOR	TOTAL = CFM	GTH	TSH	ENTERING DB	ENTERING WB	MODEL NUMBER	AIR QUANTITY	TC	SHC

Notes: Select unit on basis of air quantity, sensible heat capacity (SHC) and total capacity (TC) based on entering air conditions (EDB) (EWB) to evaporator coils to match total sensible heat (TSH) and Grand Total Heat (GTH) loads. When sensible heat capacity is insufficient, room conditions cannot be met.

HEATING ESTIMATE

Room Temperature (occupied) ________ F (unoccupied) ________ F Outdoor Temperature ________ F

Items	Description	Quantity		R0	R4	R7	R11	R13	R19	= BTUH/°F
Glass Windows/doors	Single Pane		sq ft	1.13	.....	.....	.....	.....	.....	
	Double Pane		sq ft	.61	.....	.....	.....	.....	.....	
Walls-Light	8" lt. wt. agg. concrete block or frame		sq ft	.34	.15	.10	.07	.06	.....	
Walls-Medium	4" concrete block with 4" brick facing plastered		sq ft	.39	.15	.11	.07	.06	.....	
Walls-Heavy	8" brick-plaster finish		sq ft	.45	.16	.11	.08	.07	.....	
Roofs-Light	Preformed slab NO ceiling		sq ft	.22	.....	.09	.....	.06	.04	
Roofs-Light	Same w/suspended acoustical tile ceiling		sq ft	.14	.....	.07	.....	.05	.04	
Roofs-Medium	4" concrete NO ceiling		sq ft	.56	.....	.11	.....	.07	.05	
Roofs-Medium	Same w/suspended acoustical tile ceiling		sq ft	.23	.....	.09	.....	.06	.04	
Floors	2" concrete over vented crawl space		sq ft	.48	.....	.11	.08	.07	.....	
	Same over enclosed space or unheated basement		sq ft	.24	.....	.05	.04	.03	.....	
	Hardwood floor over vented crawl space		sq ft	.33	.....	.10	.07	.06	.....	
	Same over enclosed space or unheated basement		sq ft	.16	.....	.05	.03	.03	.....	
	Concrete slab on grade (perimeter) (Note 1)		lin ft	.85	.....	.....	.....	.....	.....	
Basement	6" Masonry wall (perimeter)		lin ft	.05	.....	.....	.....	.....	.....	
Infiltration (See Note 4)	1/2 air change (floor area)		sq ft	.01	.....	.....	.....	.....	.....	
	3/4 air change (floor area)		sq ft	.015	.....	.....	.....	.....	.....	
	1 air change (floor area)		sq ft	.020	.....	.....	.....	.....	.....	
		Sub Total (1)								
Ventilation	Outdoor air thru apparatus		cfm	1.1	.....	.....	.....	.....	.....	
		Sub Total (2)								

Unoccupied Heating Load	Occupied Heating Load
Sub Total (1) x Unoccupied Rm. Temp-Outdoor Temp. = BTUH	Sub Total (2) x Occupied Rm. Temp.-Outdoor Temp. = BTUH.
________ x ________ T.D. = ____________* BTUH	________ x ________ T.D. = ____________ BTUH.
If Unoccupied or Setback Temp. is 10 F below Occupied Temp. Set Back Capacity Equals:	Less Credit for Lights = ____________ BTUH. (Note 4)
Unocc. Htg. Load ____________* x 1.20 = ________BTUH.	Occupied Heating Capacity = ____________ BTUH.

Select heating equipment to have the capacity to match or exceed the occupied or unoccupied capacity, whichever is greater. Unoccupied load is based on outside air intake damper being closed.

NOTES:

1. For concrete floor on ground figure lineal feet of exposed edge.
2. For pitched roof use area of ceiling.
3. Infiltration – Tight building 1/2 air change, medium building 3/4 air change, loose building 1 air change.
4. Credits can be taken only when these heat loads are dependable and available during occupied times.

Table 10 Combustion Calculations—Molal Basis

LINE	Fuel, O_2, and Air per Unit of Fuel: Fuel Constituent	Per Fuel Unit, lb	Mol. Wt Divisor	Moles Fuel Constituent	O_2 Multiplier	O_2 Moles Theo Reqd	Flue Gas (F.G.) Composition Moles per Fuel Unit (AF): $CO_2 + SO_2$	O_2	N_2	H_2O	CO
1	C to CO_2		12		1						
2	C to CO		12		.5						
3	CO to CO_2		28		.5						
4	C unburned, line k		12								
5	H_2		2		.5						
6	S		32		1						
7	O_2 (deduct)		32		1						
8	N_2		28								
9	CO_2		44								
10	H_2O		18								
11	Ash										
12	Sum										
	O_2 and Air, Moles for Total Air = % (see line d at right)										
13	O_2 (theo) reqd = O_2, line 12										
14	O_2 (excess) = $\frac{T.A. - 100}{100} \times O_2$, line 12										
15	O_2 (total) supplied = lines 13 + 14										
16	N_2 supplied = $3.76 \times O_2$, line 15										
17	Air (dry) supplied = $O_2 + N_2$										
18	H_2O in air = moles dry air $\times \frac{A}{B - A}$ *										
19	Air (wet) supplied = lines 17 + 18										
20	Flue gas constituents = lines 1 to 18, total										

Conditions—Assigned or Observed and Miscellaneous

Date

			LINE
Fuel *Natural Gas*			
Source *California*			
Fuel Unit {100 lb, solid or liquid fuels; 100 moles, gaseous fuels}			
Fuel Anal. as Fired (AF), % by Wt or Vol			a
CH_4	*Moles C & H_2/100 Moles fuel*	*C* / *H_2*	
C_2H_6	*In CH_4*		b
O_2	*In C_2H_6*		
N_2	*Totals*		
CO_2	*No unburned fuel*		
100.0			
CO_2	O_2 CO N_2	%†	c
Total air (T.A.) assigned or by ORSAT		%	d
Lines f, g, h For Gaseous Fuels			e
Wt, fuel unit = Σ (moles each × mol. wt) lb			f
Mol. wt of fuel = line f ÷ 100			g
Density of fuel @ 80 F & 30 in. = $\frac{\text{line g}}{394}$ $\frac{\text{lb}}{\text{cu ft}}$			h
Fuel heat value, Btu/lb /cu ft			i
Combustible in refuse, % "C"		%	j
Carbon unburned, lb/100 lb fuel = % ash in fuel × $\frac{\% \text{"C"}}{100 - \% \text{"C"}}$			k
Exit temp of flue gas, t_2		F	l
Dry-bulb (ambient) temp, t'_1		F	m
Wet-bulb temp		F	n
Rel humid. (psychrometric chart)		%	o
B*, barometric pressure, in. Hg			p
Sat. press. H_2O at amb temp, in. Hg			q
A*, press. H_2O in air, lines (o × q), in. Hg			r
Total Moles	Wet Flue Gas	Dry Flue Gas	s

21 *Note—for air at 80 F and 60% relative humidity, $\frac{A}{B-A} = 0.0212$ is often used as standard.

Determination of Flue Gas and Combustible Losses in Btu per Fuel Unit (AF)

LINE		CO_2+SO_2	O_2	N_2	H_2O	CO	Total
22	Flue gas constituents	CO_2+SO_2	O_2	N_2	H_2O	CO	Total
23	Mc_p, mean, t_2 to t'_1 (for t'_1 = 80 F, see Fig. 2)	*9.55*	*7.12*	*7.0*	*8.1*		
24	In dry flue gas = moles each, line 20 × $Mc_p \times (t_2 - t'_1)$						
25	In H_2O in air = moles H_2O, line 18 × $Mc_p \times (t_2 - t'_1)$						
26	In sens heat, H_2O in fuel = moles, lines (5 + 10) × $Mc_p \times (t_2 - t'_1)$						
27	In latent heat, H_2O in fuel = moles, lines (5 + 10) × 1040 × 18						
28	Total in wet flue gas						
29	Due to carbon in refuse = line k × 14,100						
30	Due to unburned CO in flue gas = moles C to CO × 12 × 9,755						
31	Total flue gas losses – unburned combustible = lines 28 + 29 + 30						Total
32	Heat value of fuel unit = 100 × line i for solid and liquid fuels; 394 × line i × 100, for gaseous fuels						
33	Stack and combustible loss, % of heat input = 100 × line 31 ÷ line 32						%

†Note: Flue gas analysis by ORSAT. If CO is present in flue gases, a carbon balance is used to determine distribution of C, thus:
All C in fuel = C in flue gas constituents + C in refuse. Moles C in fuel = % C by analysis ÷ 12.
Moles C in refuse = line k ÷ 12. Moles C in CO_2 = (moles C in fuel – moles C in refuse) × % CO_2 by ORSAT ÷ % (CO_2 + CO) by ORSAT.
Moles C in CO = moles C in fuel – moles C in refuse – moles C in CO_2.

TEAM LEADER'S VISIT REPORT

The team leader's visit report will consist of the EES Energy Survey form and all data sheets that were completed during the visit. These forms will be forwarded to the Project Director with a covering summary report by the Friday following the visit.

The summary report will give a brief description of plant operations and will explain the data that were collected including the conclusions and judgements arrived at by the team. The following information is to be included: (A sample report is attached)

1. The company name
2. The date of the visit
3. The names and titles of the principal company contacts
4. The names of the visit team members
5. A summary of findings
   a. Description of plant operations
   b. Energy and materials information
      1) Primary fuels used -- quantity/year -- storage capacity
      2) Auxiliary fuel used -- quantity/year -- storage capacity
      3) Raw materials used and sensitivity
      4) Waste products -- disposition -- energy potential
   c. Energy conservation information
      1) List of processes evaluated with description of findings
      2) List of potential energy conservation measures noted

d. Economic information

1) Energy cost compared with total cost or total revenues

2) Effects of fuel cut-backs on production and employment

6. Additional Comments

a. Attitude of management toward energy conservation

b. Special plant problems

1) Start-up shut down problems

2) Special safety needs (fuel related)

c. Problems encountered

d. Recommended procedural changes

PROPRIETARY

SIC # ___________

VISIT REPORT SUMMARY

Company: XYZ Carpet Company

Date: 26 September 1974

Company Contacts & Titles: Bill Smith, Manager; Larry Jones, Engineer

Visit Team: John Tatom, John Murphy, Max Akridge

SUMMARY OF FINDINGS:

Description of Operations:

This plant is a tufting and finishing plant. Some carpets are tufted with pre-dyed yarn but most of them are tufted and dyed in the plant. The sequence of operations is: 1) tufting, 2) dyeing, 3) drying, 4) application of backing, 5) trimming, and 6) shipping. Steps 2, 3, and 4 consume the most energy. The primary fuel for steps 1 and 5 is electricity.

Energy and Materials:

Main fuel used is natural gas -- about 100×10^6 cubic feet per year. This is used for driers and space heating.

They have one coal fired boiler for the dye Beck's. Consumption about 4,500 tons/year; storage capacity about 1,000 tons.

Secondary fuel is #2 fuel oil -- about 70,000 gallons/year; storage capacity about 30,000 gallons.

The primary raw materials used are natural and synthetic fibers, jute, and latex. The synthetic fibers are periodically in short supply. The process is very sensitive to the availability of all these materials.

The principal waste products are carpet trimmings (about   ton/year) and latex (about   ). The trimmings go to landfills and the latex goes to the supplier.

PROPRIETARY

Energy Conservation:

The following processes evaluated:

Boiler -- rated 35.5k #/hr @ 125 psig & 360°F fuel economy approximately 83 percent.

Drying Oven -- approximately 60 percent of the heat used in evaporating moisture; approximately 20 percent went up the stack; approximately five percent carried in the carpet; approximately 15 percent lost in other ways; such as radiation, convection, etc.

Space Heating -- Plant operates under negative pressure due to Beck exhaust fans. Only the offices are air conditioned; evaporative cooling is used around tufting operations.

Insufficient data was taken to estimate heating loads, losses, etc. The overall heating problem is very complex.

Dye Becks -- Energy losses

a) While water is boiling -- the losses vary depending upon the outside temperature but fall in the range 2×10^6 to 4.5×10^6 Btu/hr.

b) While water is not boiling (loading, unloading, heat-up, etc.) -- the losses vary depending upon the outside temperature, falling in the range $.5 \times 10^6$ to 2.5×10^6 Btu/hr.

c) Dumped hot dye water -- averages 4.4×10^6 Btu/cycle. The number of cycles vary from one every two hours to one every five hours with one every three hours being typical.

d) Dumped hot pre-rinse water -- varies from 2×10^6 Btu/cycle depending on the type of carpet and the number and type of pre-rinses. The following potential energy conservation measures were noted:

1. Don't mix hot and cold water in the same holding tank.
2. Float six inches of spoxy-glass covered urethane foam on top of holding pond water.
3. Use a larger, more efficient heat exchanger to extract heat from the dump water.
4. Modify the dye cycle to permit starting with 120-130°F dye and pre-rinse water. (This has been done at some plants)
5. Turn-off exhaust fans over those Becks which are not steaming. Observation indicates that at any given time two to four Becks are not steaming.
6. Put covers or doors on back opening of Becks.
7. Don't boil Beck water so hard. If rolling boil is wanted, it should only be mild and not violent as was observed.
8. Too much air is being exhausted from the drying oven. The relative humidity is so low that much more of the air should be recirculated than is presently the case.
9. Too much air is being exhausted from the curing oven. The purpose of this oven is to provide the optimum temperature for latex curing; it is being operated like a drying oven.

Economic Information: Cost information was not available. Energy costs represent one percent of the value of shipments. Discussions with the plant manager indicated that the process is very much energy dependent and that they would be hurt badly by a major fuel shortage. They have enough fuel on hand to operate for 30 days and should be able to weather minor shortage situations.

PROPRIETARY

Comments:

The plant visit was successful. Plant personnel were cordial and plant management appears to be very energy conscious. Even though the plant has enough fuel on hand to survive short-term shortages, they will have their growth severely restricted unless more fuel supplies are found or energy conservation measures are instituted.

The plant does not have any special shut-down or start-up problems.

The plant does have to use large exhaust fans in certain areas, (dye becks and driers) to keep fumes and steam out of the work area.

PLANT ENERGY SURVEY PROCEDURE

1. Contact plant manager and explain this procedure.

2. Guided tour of plant--partially complete energy consumption survey.

3. Conference of team members to establish priority list of energy processes to be evaluated. Start with largest energy consumers first and work toward smaller users. When in doubt, chose process where greater energy conservation potential exists.

4. Conduct energy conservation analysis and complete energy consumption survey. (Don't forget to ask employees for energy conservation ideas)

5. Meet with plant manager to tell of preliminary findings and explain that letter report will follow.

FOLLOW UP LETTER TO PLANT MANAGER*

1. Thank you for courtesy.

2. Date of visit and contact man at plant.

3. Quick summary of findings;

   List processes evaluated and their efficiency
   List suggestions for improving these processes
   Ideas for energy savings in other processes
   Energy consciousness of employees and management

4. Enclose copy of "Employee Conservation Program" description.

5. Note copy of final report will be sent to him.

6. Emphasize confidentiality of information.

*Copies sent to:
IDD Field office representative involved
E. D. Hancock, TAG

ENGINEERING APPROACHES TO ENERGY CONSERVATION

BASIC CONSIDERATIONS IN ENERGY USE.

ENERGY SURVEY AND USE ANALYSIS.

INCREASING EFFICIENCY OF ENERGY USE.

BASIC CONSIDERATIONS IN ENERGY USE

1. Unit of energy is the B.T.U.

2. Our energy comes primarily from fuels; coal, natural gas and petroleum products (see table).

3. Uses of energy are:

   a. Plant space heating and air conditioning

   b. Produces a utility; such as,

      Electricity

      Steam

      Air

      Water

   c. Direct use in a process; such as,

      Dryer

      Oven

   d. Transportation.

4. A basic and useful concept is "Equivalent Energy Value" which is the total value of energy in B.T.U.'s of all fuel consumed in producing a utility or product.

EXAMPLES:

1 kwh of electrical energy will yield 3412 B.T.U.; but "EEV" = 10,000 B.T.U.

125 psi, 344°F saturated steam will yield 1164 B.T.U./lb, if condensed to 60°F water; but "EEV" = 1456 B.T.U./lb. if produced in a boiler of 80% efficiency.

A product ....

Raw materials ....

This concept useful:

a. As an indicator of the energy intensity of a product or utility

b. As a measure of energy consumption and energy conservation

Determined by

$$\frac{\text{Total "EEV" consumed in some time period}}{\text{Number of units produced in time period}}$$

Another concept is "Energy Dollar Value" of a utility or product. It is the cost of the "EEV".

EXAMPLE:

125 psi, 344°F steam.

"EEV" = 1456 B.T.U./lb.

at \$ 0.70/M.B.T.U.

Dollar Value = ...\$ 1.02/1000 lbs.

$$\text{Also} = \frac{\$\ 1.02}{1000\ \text{lbs.}} \times \frac{1000\ \text{lbs.}}{1.64\ \text{M.B.T.U.}} = \ldots\ldots\ldots\ldots \frac{\$\ 0.88}{\text{M.B.T.U.}}$$

ENERGY VALUE OF SOME FUELS

FUEL	ENERGY CONTENT	COST	RELATIVE COST
COAL	14,000 B.T.U./lb.	$ 30/ton	$ 1.07/M.B.T.U.
NO. 2 OIL	140,000 B.T.U./gal.	$ 0.30/gal.	$ 2.14/M.B.T.U.
NO. 6 OIL	150,000 B.T.U./gal.	$ 0.31/gal.	$ 2.07/M.B.T.U.
NATURAL GAS	100,000 B.T.U./therm.	$ 0.07/therm.	$ 0.70/M.B.T.U.
PROPANE	92,000 B.T.U./gal.	$ 0.33/gal.	$ 3.59/M.B.T.U.

ENERGY SURVEY AND USE ANALYSIS

1. List all utilities and fuels purchased and identify use.

EXAMPLE:

a. Electricity

Lighting

Process Machinery

Office Heating and Air Conditioning

Hot Water Heater

Refrigeration Compressor

Fans

b. Water

Drinking Fountains

Rest Rooms

Scalders

Refrigeration Condenser

c. Natural Gas

Plant Heating

Singers

Primary fuel for Boiler

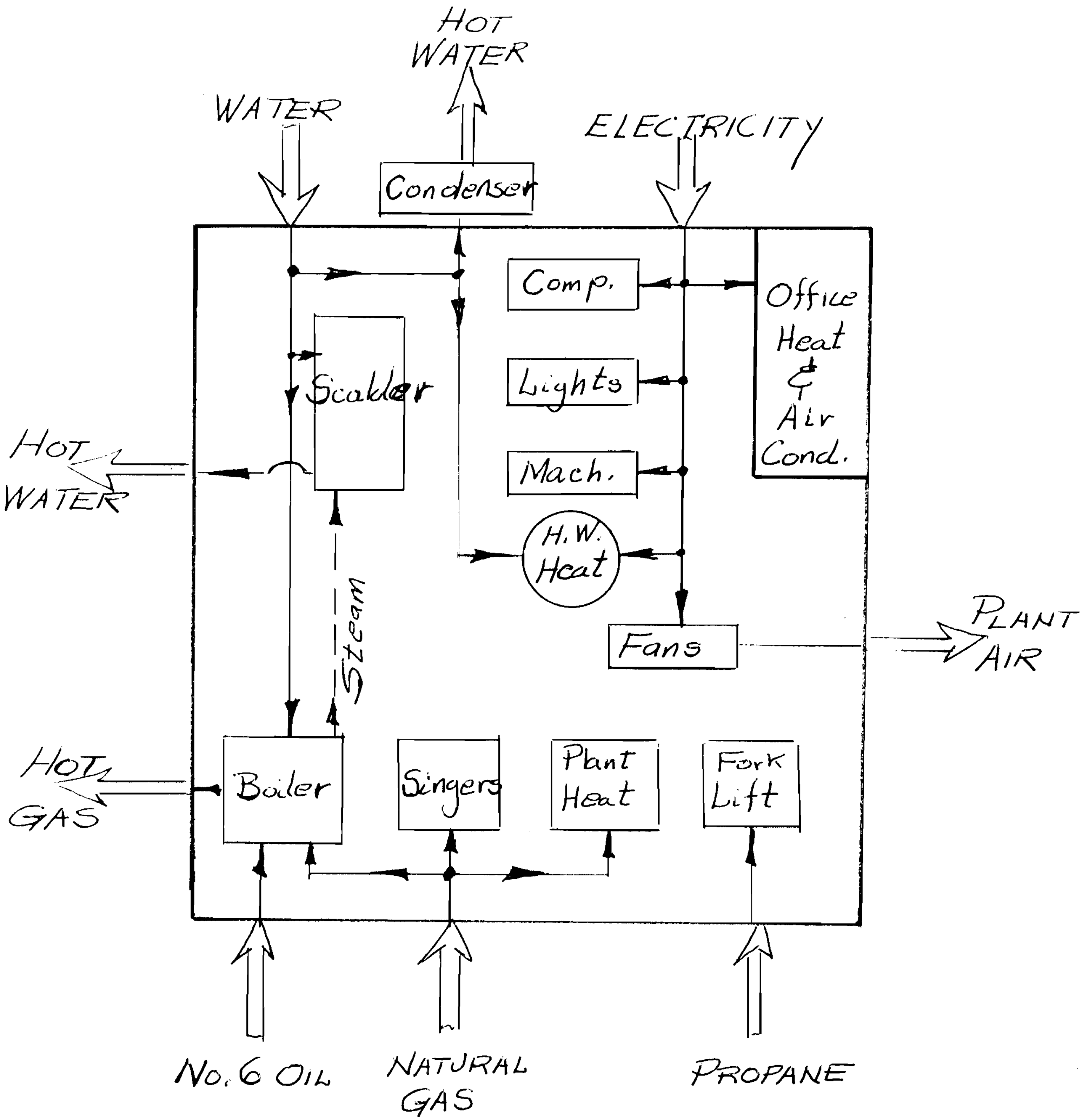
d. No. 6 Fuel Oil

Secondary Fuel for Boiler

e. Propane

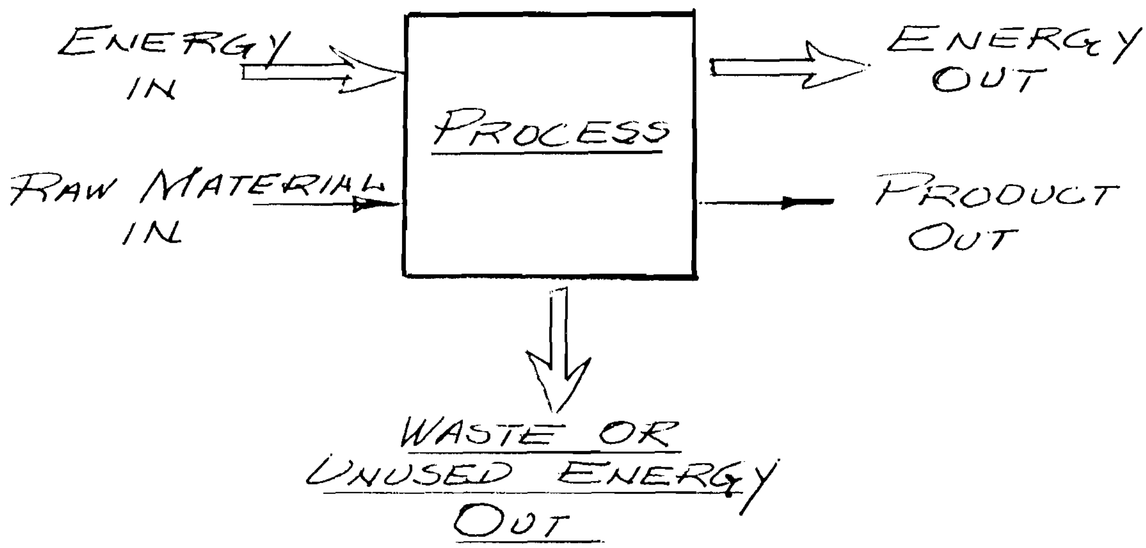
Fuel for Fork Lift

2. Construct an energy flow layout.



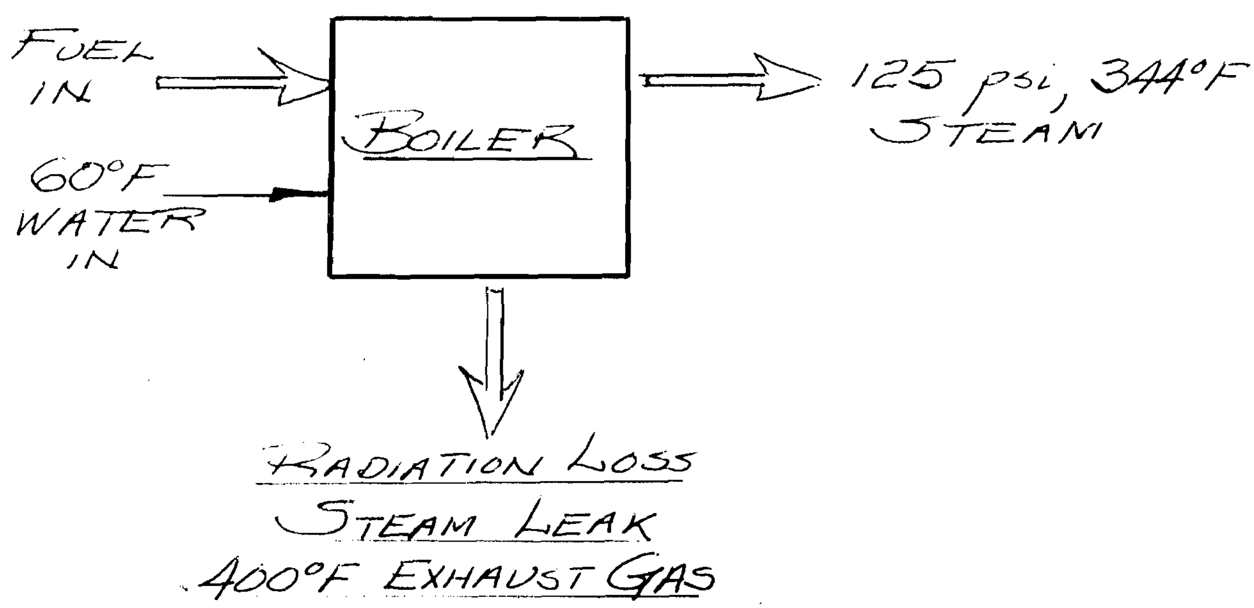
3. Continue to refine identification of energy use.

4. Take a detailed look at specific energy consuming processes to identify waste and unused energy.



EXAMPLES:

Steam Boiler



INCREASING EFFICIENCY OF ENERGY USE

1. Eliminate unnecessary use of energy.

2. Eliminate obvious losses.

3. Increase efficiency.

   Scheduling

   Equipment

4. Investigate use of unused energy.

EXAMPLES:

*1. Installation of an economizer for preheating boiler feed water.

A boiler operates an an average of 50,000 lbs./hr. of steam for 6000 hrs./year.

An economizer was installed to increase feed water temperature $60^{o}F$ for a

Cost = ...$ 42,000

Fuel Savings

$$= 60 \frac{BTU}{lb.} \times 50,000 \frac{lbs.}{hr.} \times 6000 \frac{hrs.}{yr.}$$

= 18,000 M.B.T.U./yr.

Natural Gas fired

Steam Value = $ 0.88/MBTU

Savings = (0.88)(18,000) = $ 15,840/yr.

$$\text{Payback period} = \frac{42,000}{15,840} = 2.65 \text{ years}$$

No. 6 Fuel Oil

Fuel Cost = $ 2.07/M.B.T.U.

$$\text{Steam Value} = \frac{2.07}{.8} = \$\ 2.59/\text{M.B.T.U.}$$

Savings = (2.59)(18,000) = $ 46,620/yr.

$$\text{Payback Period} = \frac{\$42,000}{46,620} = 0.9 \text{ years.}$$

* Courtesy Applied Engineering Co., Inc.

*2. A plant has a steam boiler where the value of steam is $ 1.19/MBTU.

Unused energy from stack is 12,500 MBTU/yr.

Plant expansion planned. Heating load = 1090 MBTU/yr.

Also, to preheat feedwater 50^{o}F requires 1580 MBTU/yr.

Total heat = 2670 MBTU/yr.

* Taken from NBS Handbook 115.
Prepared by Peoples National Gas Company fro Johnson Sanitary Dairy, Johnstown, Pennsylvania.

Investigate installation of economizer.

COST

Economizer and	
associated equipment	= $ 17,340
Savings from no	
separate heating	
equipment in expansion	= $ 8,300
NET	= $ 9,040

ANNUAL FUEL SAVINGS

Not heat expansion	$ 3,480
Feed water pre-heating	= (1580 x 1.19)
	1,880
TOTAL	$ 5,360

PAYBACK PERIOD = $\frac{9040}{5360}$ = 1.69 years

*3. Recirculating Curring Oven

Size: 100 ft. long

12 ft. high

20 ft. wide

Original: 16 Burners (8 Modules)

300,000 $ft.^3$/day

300,000,000 BTU/day

Now: 9 Burners

150,000 $ft.^3$/day

Savings: 150,000 $ft.^3$/day

150,000,000 BTU/day

150 MBTU/day

$150 \times 250 = 37{,}500 \frac{\text{MBTU}}{\text{yr.}}$

Estimate gas cost at $ 0.70/MBTU

37,500 (.70) =	$ 26,250
Initial Cost	$ 30,000
Payback period = $\frac{30{,}000}{26{,}250}$ =	1.14 years

* Courtesy, Coronet Industries, Dalton, Georgia.

A-1644

OBJECTIVES OF THE IN-PLANT ENERGY CONSERVATION AND MANAGEMENT PROGRAM

- O INCREASE PROFITS BY SAVINGS ON ENERGY COSTS
- O PREVENT BUSINESS OR PLANT SHUTDOWN DUE TO ENERGY SHORTAGES
- O KEEP PEOPLE WORKING
- O KEEP U.S. INDUSTRY COMPETITIVE
- O KEEP U.S. INDUSTRY AS FREE FROM GOVERNMENT CONTROLS AS POSSIBLE

A-16..

IN-PLANT ENERGY CONSERVATION AND MANAGEMENT

Program Outline

TOP MANAGEMENT COMMITMENT

- o Inform line supervisors of:
  - The economic reason for the need to conserve energy
  - Their responsibility for implementing energy saving actions in the areas of their accountability
- o Establish a committee having the responsibility for formulating and conducting an energy conservation program and consisting of:
  - Representatives from each department in the plant
  - A Coordinator appointed by and reporting to management

    Note: In smaller organizations, the manager and his staff may conduct energy conservation activities as part of their management duties.
- o Provide the committee with guidelines as to what is expected of them:
  - Plan and participate in energy saving surveys
  - Develop uniform record keeping, reporting, and energy accounting
  - Research and develop ideas on ways to save energy
  - Communicate these ideas and suggestions
  - Suggest tough, but achievable, goals for energy saving
  - Develop ideas and plans for enlisting employee support and participation
  - Plan and conduct a continuing program of activities to stimulate interest in energy conservation efforts
- o Set goals in energy saving:
  - A preliminary goal at the start of the program
  - Later, a revised goal based on savings potential estimated from results of surveys
- o Employ external assistance in surveying the plant and making recommendations, if necessary

---

Note: This program outline was extracted from ENERGY CONSERVATION AND PROGRAM GUIDE FOR INDUSTRY AND COMMERCE (EPIC). Please refer to attached order form for additional information concerning this publication.

- o Communicate periodically to employees regarding management's emphasis on energy conservation action and report on progress

SURVEY ENERGY USES AND LOSSES

- o Conduct first survey aimed at identifying energy wastes that can be corrected by maintenance or operations actions, for example:
  - Leaks of steam and other utilities
  - Furnace burners out of adjustment
  - Repair or addition of insulation required
  - Equipment running when not needed
- o Survey to determine where additional instruments for measurement of energy flow are needed and whether there is economic justification for the cost of their installation
- o Develop an energy balance on each process to define in detail:
  - Energy input as raw materials and utilities
  - Energy consumed in waste disposal
  - Energy credit for by-products
  - Net energy charged to the main product
  - Energy dissipated or wasted

    Note: Energy equivalents will need to be developed for all raw materials, fuels, and utilities, such as electric power, steam, etc., in order that all energy can be expressed on the common basis of Btu units.
- o Analyze all process energy balances in depth:
  - Can waste heat be recovered to generate steam or to heat water or a raw material?
  - Can a process step be eliminated or modified in some way to reduce energy use?
  - Can an alternate raw material with lower energy content be used?
  - Is there a way to improve yield?
  - Is there justification for:
    - . Replacing old equipment with new equipment requiring less energy?
    - . Replacing an obsolete, inefficient process plant with a whole new and different process using less energy?
- o Conduct weekend and night surveys periodically

- o Plan surveys on specific systems and equipment, such as:
  - Steam system
  - Compressed air system
  - Electric motors
  - Natural gas lines
  - Heating and air conditioning system

IMPLEMENT ENERGY CONSERVATION ACTIONS

- o Correct energy wastes identified in the first survey by taking the necessary maintenance or operation actions
- o List all energy conservation projects evolving from energy balance analyses, surveys, etc. Evaluate and select projects for implementation:
  - Calculate annual energy savings for each project
  - Project future energy costs and calculate annual dollar savings
  - Estimate project capital or expense cost
  - Evaluate investment merit of projects using measures, such as return on investment, etc.
  - Assign priorities to projects based on investment merit
  - Select conservation projects for implementation and request capital authorization
  - Implement authorized projects
- o Review design of all capital projects, such as new plants, expansions, buildings, etc., to assure that efficient utilization of energy is incorporated in the design.

  Note: Include consideration of energy availability in new equipment and plant decisions.

DEVELOP CONTINUING ENERGY CONSERVATION EFFORTS

- o Measure results:
  - Chart energy use per unit of production by department
  - Chart energy use per unit of production for the whole plant

    Note: The procedure for calculating energy consumption per unit of product is presented in "How to Profit by Conserving Energy"
  - Monitor and analyze charts of Btu per unit of product, taking into consideration effects of complicating variables, such as outdoor ambient air temperature, level of production rate, product mix, etc.

- Compare Btu/product unit with past performance and theoretical Btu/product unit
- Observe the impact of energy saving actions and project implementation on decreasing the Btu/unit of product
- Investigate, identify, and correct the cause for increases that may occur in Btu unit of product, if feasible

o Continue energy conservation committee activities

- Hold periodic meetings
- Each committee member is the communication link between the committee and the department supervisors represented
- Periodically update energy saving project lists
- Plan and participate in energy saving surveys
- Communicate energy conservation techniques
- Plan and conduct a continuing program of activities and communication to keep up interest in energy conservation
- Develop cooperation with community organizations in promoting energy conservation

o Involve employees

- Service on energy conservation committee
- Energy conservation training course
- Handbook on energy conservation
- Suggestion awards plan
- Recognition for energy saving achievements
- Technical talks on lighting, insulation, steam traps, and other subjects
- "savEnergy" posters, decals, stickers
- Publicity in plant news, bulletins
- Publicity in public news media
- Letters on conservation to homes
- Talks to local organizations

o Evaluate program

- Review progress in energy saving
- Evaluate original goals
- Consider program modifications
- Revise goals, as necessary

WHY MEASURE ENERGY

As energy is used more effectively, product costs can be reduced and profits improved. This can be accomplished even in the face of sharply increasing energy costs. Since industrial energy consumption accounts for approximately 40% of total energy used in the United States, significant contributions can be made to the national effort.

The first step to meaningful energy conservation is measurement of all the energy that enters and leaves a plant during a given period. This measurement will probably be an approximation at first but should improve with experience.

To calculate the energy content of your products, use the attached form, and then set goals for improvement. The filled in example is for ethylene; but the procedure applies equally well to any manufacturing operation, be it a grain mill pulp mill, steel mill, furniture factory, or assembly line.

Though time consuming and challenging to make the initial calculations, it will be worth the effort. Raw materials which contain, and manufacturing processes which use large amounts of energy will be pinpointed.

What To Expect – Once BTU content is determined, products can be ranked by BTU'S per unit, BTU'S per dollar of sales, and BTU'S per dollar profit. Then, as energy availability becomes more limited, it will be possible to quickly focus on the most profitable products.

Equipment associated with the large energy consuming steps will be identified. Once the energy-hogging equipment is isolated, efforts can be focused on replacing old machinery and equipment, using more energy-conscious designs, and improving maintenance programs.

Less energy-intensive raw materials should escalate less in price as energy costs increase. Having determined the energy content of raw materials, and given a choice, a better raw material selection should be possible.

Stressing the importance of BTU'S per-unit-of-production to plant operating people should provide the incentive for them to chase down where all of the input BTU'S actually end up. Often, the first attempt will account for less than 50% of the input BTU'S. Simply the act of identifying the other 50% will reveal many opportunities for improvement. For example:

1. A reduction in scrap or an improvement in yield will often be the most significant energy reduction that can be accomplished.
2. Leaking water, steam, inert gas or raw material may seem quite small as it escapes into the air, but over time this can represent a sizeable quantity of energy.
3. Heat loss from equipment can sometimes be reduced with more insulation once the losses are identified.
4. Sometimes energy lost to the environment, either through cooling water or through air, can be used advantageously to heat inlet raw materials or process equipment.
5. The energy content of waste may be recovered in part or in total by treating and recycling the waste back through the manufacturing process. In some instances, it may be possible to burn the waste and use the recovered heat in the process.
6. Temperature control equipment may be alternately heating and cooling. This problem is often corrected by a simple adjustment of the controls.
7. Recognizing that it takes 10,000 BTU'S to generate one KWH may suggest using less electricity for heating since this same KWH is capable of producing only 3,413 BTU'S of heat.
8. It may be possible to combine some manufacturing steps so that the product does not cool down between steps and subsequently have to be reheated before it is processed further.

The energy shortage is a national concern. It can also be viewed as an exciting challenge. Those companies that move quickly to meet the challenge will contribute substantially to the solution of a national problem – and make money at it.

The first step is measurement.

DEPARTMENT ____________________

MONTHLY DEPARTMENT ENERGY USE

	ELECTRIC POWER			NATURAL GAS			FUEL OIL			COAL			COMPRESSED AIR		
1973	kWh	Btu/kWh	Btu	k cu ft	Btu/k cu ft	Btu	gal	Btu/gal	Btu	TONS	Btu/lb	Btu	k cu ft	Btu/k cu ft	Btu
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

ATTACHMENT B

DEPARTMENT ____________________

MONTHLY DEPARTMENT ENERGY USE

	psig STEAM			psig STEAM			CONDENSATE USED OR LOST			WATER			TOTAL CONVERSION Btu	NUMBER OF UNITS PRODUCED	CONVERSION Btu PER UNIT OF PRODUCTION
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

DEPARTMENT ____________

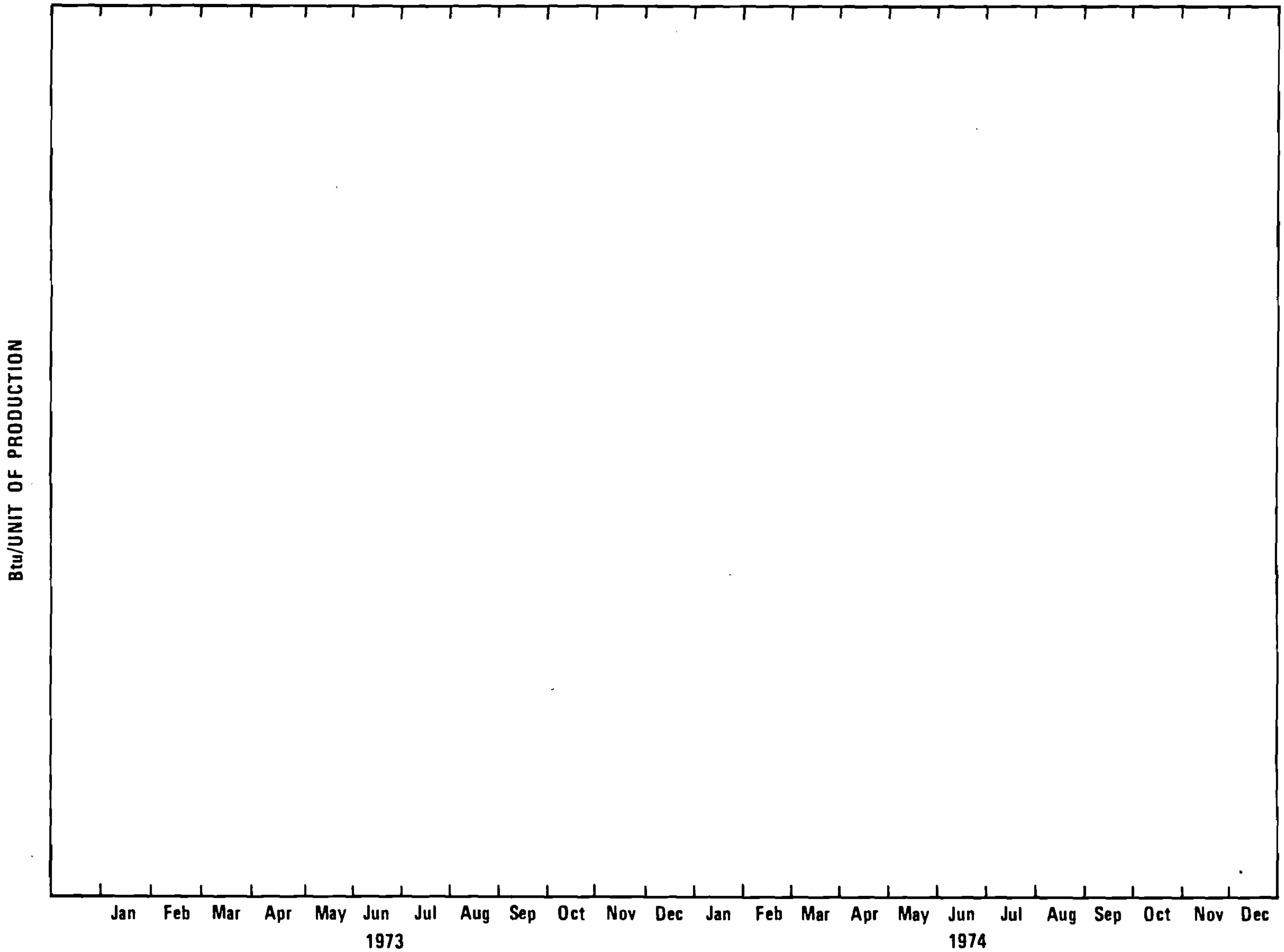
MONTHLY DEPARTMENT ENERGY USE

	RAW MATERIAL "A"			RAW MATERIAL "B"			RAW MATERIAL "C"			Total Raw Material Btu	Raw Material Btu Per Unit of Production	Total Conversion & Raw Material Btu Per Unit of Production
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												
1974												
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												

Tracking Chart

Energy Use Per Unit of Production

Attachment C



2.6 First Energy Saving Survey

The survey team's plan for the first survey was approved by the Energy Conservation Committee, you recall. Now we have a sequence of four letters regarding the survey. The manager endorses the survey plan. The team submits their timetable to department heads. Findings of the survey are reported. Finally, the team suggests the need for foreman training in energy conservation. Note the application of:

- Survey
- Employee involvement
- Top management commitment

2.7.3

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker, Energy Conservation Coordinator

Subject: Energy Saving Project Lists and Project Evaluation Summary

Some of our energy conservation projects will require capital; others can be done on expense. Therefore, we should have two separate lists of projects. In order to have the lists in a uniform format, the two attached forms for capital and expense projects are provided for use by all departments.

The ratio of energy savings/year per dollar invested is an indicator of how good a project is, compared to other projects. The higher the number, the better the project. In the forms, a column for percent return on investment is also included as an aid in assigning priorities on projects.

Also attached is an evaluation summary form to be used for each project.

Please submit copies of these forms to the key supervisors in your area and request that they enter their project information and return completed copies (lists and evaluations) before our next meeting one month from today.

Our manager, Mr. Parker, has requested that we continue working on the lists, revising and updating them monthly, adding new projects that evolve and additional maintenance jobs that become necessary.

cc: D. T. Parker, Plant Manager

ENERGY CONSERVATION
CAPITAL PROJECTS

Department: ____________

Date: ____________

Project Number	Project Description	Energy Savings Btu/Year	Capital Cost $	Ratio $\frac{\text{Btu/Year Saving}}{\text{\$ Capital}}$	Percent ROI	Priority	Status

ENERGY CONSERVATION
EXPENSE PROJECTS

Department: ______________

Date: ______________

Project Number	Project Description	Energy Savings Btu/Year	Expense Cost $	Ratio Btu/Year Saving / $ Expense	Percent ROI	Priority	Status

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Capital ________ or Expense ________

Department ____

Date ________________________

Project No. ______ Person Responsible ____

Project Title: ____

Description of Project: ____

____

____

____

____

Location: ____

<u>Financial Evaluation</u>

Estimated

Energy saving (electric power kWh/yr steam lb/yr etc.)

Utility or Raw Material	Saving
____________________	____________________ /yr
____________________	____________________ /yr
____________________	____________________ /yr
Total energy saving	____________________ MBtu/yr
Total energy cost saving	____________________ $/yr
Other cost saving due to:	
____________________	____________________ $/yr
Additional cost due to:	
____________________	____________________ $/yr
Net cost saving	____________________ $/yr
Cost of project	____________________ $

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Calculated

Return on investment ______________ %

Pay back period ______________ months

Other ______________ ______________

Btu/unit of production: Now ______________ After project implemented ______________

Benefits/Problems

Product quality ______________

Product yield ______________

Production rate ______________

Safety ______________

Pollution ______________

Maintenance-manpower/materials ______________

Utilities ______________

Working conditions ______________

Employee attitude ______________

Community ______________

Other benefits/problems connected with implementation:

____

____

____

Comments: ______________

____

Project rating: ______________

____

____

Planned authorization request date: ______________

2.7.4

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Energy Conservation Committee

From: T. G. Marshall, Maintenance

Subject: Communication of Ways to Save Energy

I have assembled a group of ECO's from EPIC, which are particularly applicable in our operation, along with a few good articles from the literature. I propose that we publish this as a booklet for plant wide use by supervisors. A copy of the list of ECO's chosen is attached hereto. After each of you has looked over the copy and indicated your approval, I will proceed with publication and distribution.

May I suggest that this booklet could be a useful tool in a training course as suggested in the recent letter from W. D. Smith and A. B. Jones.

cc: D. T. Parker
Plant Manager

NBS-114A (REV. 7-73)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBS HB-115	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE
Energy Conservation Guide for Industry and Commerce (EPIC)

5. Publication Date: Sept. 1974

6. Performing Organization Code:

7. AUTHOR(S) Robert R. Gatts, Robert G. Massey, John C. Robertson

8. Performing Organ. Report No.:

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.: 4314560

11. Contract/Grant No.:

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*
Sponsored in Part by the Federal Energy Administration, Conservation and Environment, Washington, D. C. 20500

13. Type of Report & Period Covered: Final

14. Sponsoring Agency Code:

15. SUPPLEMENTARY NOTES
Main document designed as a handbook. Supplemental pages will be added on a periodical basis to expand and/or up-date this handbook.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The Energy Conservation Program Guide for Industry and Commerce (EPIC) is a guide to assist business and industry to establish an on-going conservation program. EPIC outlines the steps in an energy conservation program and suggests specific ways to reduce energy use in manufacturing and commercial businesses. EPIC focuses on two aspects of energy conservation:

(1) The key steps in an implementation plan for an energy conservation plan.

(2) Energy Conservation opportunities which have been identified by industry.

Library of Congress Catalog Card No. 74-600153.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*
Energy conservation; energy conservation guide; energy conservation opportunities; energy conservation program; industrial energy conservation.

18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[X] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13.11:115

[ ] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PAGES
UNCLASSIFIED	212
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	2.50

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Superintendent of Documents,
Government Printing Office,
Washington, D.C. 20402

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    - (B) PERIODIC BACK FLUSHING.
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A-1644

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U.S. Department of Commerce
Economic Development Administration
Office of the Assistant Secretary
Washington, D. C. 20230

Sept. 20, 19.74...
Project No. A-1644
Period 6/10/74 to 8/31/74

PERSONNEL ITEMIZATION

Grant No. 99-6-09359

Name	Position or Title	Amount
N. J. Goodson	Clerk Typist III	$ 42.78
C. L. Ramsey	Clerk I	3.75
D. L. Wooten	Secretary I	426.23
S. B. Wheeler	Secretary II	362.25
C. H. Bonham	Research Engineer	1,030.77
D. S. Clifton	Research Scientist	974.82
J. W. Tatom	Principal Research Engineer	2,273.74
S. G. Daniell	Assistant Research Scientist	32.77
J. J. Miller	Secretary II	10.36
J. M. Akridge	Sr. Research Engineer	2,396.80
J. F. Kinney	Sr. Research Engineer	1,040.04
M. A. Clarke	Secretary III	36.75
J. L. Birchfield	Research Engineer	561.75
P. H. Har-oz	Assistant Research Engineer	556.75
R. M. Mason	Research Scientist	30.32
T. D. Cutler	Co-op Student	166.80
D. A. Burch	Secretary II	5.41
M. P. Cole	Clerk II	20.46
G. K. Webb	Artist	25.41
J. H. Murphy	Sr. Research Engineer	297.14
R. S. Jenkins	Mach. Tech. III	230.41
L. R. Edens	Research Engineer	322.42
B. K. Summers	Secretary I	52.50
W. T. Studstill	Research Engineer	136.42
S. L. Dudley	Assistant Research Scientist	213.74
H. G. Dean	Principal Research Engineer	1,275.07
R. L. Yobs	Assistant Director	90.95
R. L. Somers	Assistant Research Engineer	245.65
		$ 12,862.26

Cash Federal	7,224.61
Cash Grantee	5,637.65
	$ 12,862.26

PLEASE MAKE ALL CHECKS PAYABLE TO GEORGIA TECH RESEARCH INSTITUTE

A-1644 September 20, 1974

Budget Bureau No. 41-R2448; Approval Expires April 30, 1971

Grantee Organization	Address	FORM ED-325 (5-7-68) U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION	IMPORTANT: Prepare this report in triplicate. File within 15 days after the end of the period covered. Submit original and one copy to:	Period Covered
Georgia Tech Research Institute	Georgia Tech Research Institute Georgia Institute of Technology Atlanta, Georgia 30332	**FINANCIAL REPORT** **TITLE III TECHNICAL ASSISTANCE GRANTS** *(Section 301(a) of Public Law 89-136)*	Office of Technical Assistance Economic Development Administration U. S. Department of Commerce Washington, D. C. 20230	From 6/10/74
Grant No. 99-6-09359				To 8/31/74
Report No. 1				

*Grantee - Round amounts to nearest whole dollar Budget Category	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	7,225	5,638	-	12,863	7,225	5,638	-	12,863	73,469	25,891	-	99,360	66,244
2. Consultant and Contract Services: (a) Consultants	-	-	-	-	-	-	-	-	-	-	-	-	-
(b) Contract Services													
Total Consultants and Contracts	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Travel: (a) Transportation	186	-	-	186	186	-	-	186	4,000	-	-	4,000	3,814
(b) Per Diem													
Total Travel	186	-	-	186	186	-	-	186	4,000	-	-	4,000	3,814
4. Space Costs and Rentals: (a) Space (Rent or Use)	-	-	-	-	-	-	-	-	-	-	-	-	-
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Other Costs: (a) Consumable Supplies	12	-	-	12	12	-	-	12	3,500	-	-	3,500	3,488
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous													
Total Other Costs	12	-	-	12	12	-	-	12	3,500	-	-	3,500	3,488
6. Costs Not Listed Above: *(Itemize)* (a) Employee Retirement Benefits	322	483	-	805	322	483	-	805	6,246	2,270	-	8,516	5,924
(b) Overhead	4,696	3,664	-	8,360	4,696	3,664	-	8,360	47,755	16,829	-	64,584	43,059
(c)	-	-	-	-	-	-	-	-	-	-	-	-	-
(d)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Itemized Costs	5,018	4,147	-	9,165	5,018	4,147	-	9,165	54,001	19,099	-	73,100	48,983
TOTALS →	12,441	9,785	-	22,226	12,441	9,785	-	22,226	134,970	44,990	-	179,960	122,529

Name (1)	Title or Position (2)	Annual Salary (3)	Rate Per Da. Wk. Mo. (4)	Time Worked This Period Das. Wks. Mos. (5)	Expenditures This Period: Cash Federal (6)	Cash Grantee (7)	In-Kind Grantee (8)	Total Expenditures This Period (9)
TOTAL ⟶	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.	See attached sheet for personnel itemization.						

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

George R. Brock - Accountant I
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen - Sr. Grants and Contracts Officer
(Director of Grantee Organization)

(Signature)

Sept. 20, 1974
(Date)

(Signature)

(Date)

FORM ED-325 (5-7-68) USCOMM-DC 30970-P68

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistant Secretary
Washington, D. C. 20230

January 21, 19 75

Project No. A-1644

Period 9/1/74 to 12/31/74

PERSONNEL ITEMIZATION
Grant No. 99-6-09359

NAME	POSITION OR TITLE	AMOUNT
D. A. Burch	Secretary II	$ 123.64
V. E. Reid	Secretary I	5.05
L. W. Elston	Sr. Research Engineer	30.76
C. H. Bonham	Research Engineer	2,198.85
D. S. Clifton	Research Scientist	2,160.19
J. L. Birchfield	Research Engineer	713.33
A. Bauman	Engineer-Draftsman II	43.28
L. G. Harley	Secretary II	6.21
D. R. Hurst	Chem. Tech. III	194.71
M.P. Cole	Clerk II	140.32
E. D. Hancock	Secretary II	904.40
A. R. Colcord	Sr. Research Engineer	453.64
J. H. Murphy	Sr. Research Engineer	2,935.67
J. W. Tatom	Prin. Research Engineer	2,768.63
D. L. Wooten	Secretary I	227.64
R. J. Barker	Secretary I	1.75
J. F. Kinney	Sr. Research Engineer	3,074.10
J. M. Akridge	Sr. Research Engineer	3,670.11
S. B. Wheeler	Secretary II	157.50
H. G. Dean	Prin. Research Engineer	775.75
T. D. Cutler	Co-op Student	(2.00)
S. D. Dodson	Clerk-Typist I	39.00
D. E. Lodge	Sr. Research Scientist	71.33
B. J. Smith	Secretary I	257.25
N. S. McHan	Secretary II	12.43
R. G. Pearl	Research Engineer	159.61
S. T. Alford	Sr. Research Engineer	214.00
R. S. Jenkins	Mach. Tech. III	87.50
R. R. Sheppard	Asst. Research Engineer	175.00
T. D. Harris	Co-op Student	386.40
W. H. Hicklin	Research Engineer	234.00
L. W. Hurd	Clerk-Typist I	38.98
W. C. Darley	Research Engineer	690.33
G. K. Webb	Artist	37.31
P. H. Har-Oz	Asst. Research Engineer	1,710.21
M. F. Munoz	Sr. Research Engineer	938.29
R. A. Clayton	Asst. Research Scientist	1.33
W. N. Craig	Asst. Research Engineer	217.01
P. D. Kisselburg	Secretary II	3.83
W. T. Studstill	Research Engineer	263.35
		26,120.69
	Cash Federal	16,643.46
	Cash Grantee	9,477.23
		$ 26,120.69

IN ACCOUNT WITH.

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistant Secretary
Washington, D. C. 20230

April 25, 19 75

Project No A-1644

Period 1/1/75 to 3/31/75

PERSONNEL ITEMIZATION
Grant No. 99-6-09359

NAME	POSITION OR TITLE	AMOUNT
G. K. Webb	Artist	$ 37.31
W. T. Studstill	Research Engineer	79.80
P. W. Potts	Research Scientist	36.38
F. Kingsland	Research Engineer	470.80
D. A. Ariail	Secretary III	35.28
R. E. Cornman	Research Scientist	78.02
		$ 39,848.22

Cash Federal	37,506.34
Cash Grantee	2,341.88
	$ 39,848.22

I.	Project Director	$ 6,548.40
II.	Research Scientists and Research Engineers	30,433.07
III.	Support Personnel	2,866.75
		$ 39,848.22

Address
Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, Georgia 30332

Grant No. 99-6-09359

Report No. 2

FORM ED-325 (5-7-68)

U.S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION

FINANCIAL REPORT
TITLE III TECHNICAL ASSISTANCE GRANTS
(Section 301(a) of Public Law 89-136)

IMPORTANT: Prepare this report in triplicate. File within 15 days after the end of the period covered. Submit original and one copy to:

Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20230

Period Covered
From 9/1/74
To 12/31/74

*Grantee - Round amounts to nearest whole dollar Budget Category	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	16,643	9,477		26,120	23,868	15,115	-	38,983	73,469	25,891	-	99,360	49,601
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	396	-		396	582	-	-	582	4,000	-	-	4,000	3,418
(b) Per Diem													
Total Travel	396	-		396	582	-	-	582	4,000	-	-	4,000	3,418
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	1,231	-		1,231	1,243	-	-	1,243	3,500	-	-	3,500	2,257
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous													
Total Other Costs	1,231	-		1,231	1,243	-	-	1,243	3,500	-	-	3,500	2,257
6. Costs Not Listed Above: *(Itemize)* (a) Overhead	10,818	6,160		16,978	15,514	9,824	-	25,338	47,755	16,829	-	64,584	32,241
(b) Employee Retirement Benefits	1,035	831		1,866	1,357	1,314	-	2,671	6,246	2,270	-	8,516	4,889
(c)													
(d)													
Total Itemized Costs	11,853	6,991		18,844	16,871	11,138	-	28,009	54,001	19,099	-	73,100	37,130
TOTALS →	30,123	16,468		46,591	42,564	26,253	-	68,817	134,970	44,990	-	179,960	92,406

PERSONNEL ITEMIZATION (Round amounts to nearest whole dollar)

	Title or Position	Annual Salary	Rate Per Da. Wk. Mo.	Time Worked This Period Das. Wks. Mos.	Expenditures This Period * Cash Federal	Cash Grantee	In-Kind Grantee	Total Expenditures This Period
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TOTAL ⟶	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

George R. Brock - Accountant I
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen - Sr. Grants and Contracts Officer
(Director of Grantee Organization)

(Signature) 1/22/75 *(Date)*

(Signature) *(Date)*

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistance Secretary
Washington, D. C. 20230

Feb.20, 19 76

Project No. A-1644

Period 7/1/75 to 1/31/76

FINAL REPORT

PERSONNEL ITEMIZATION
Grant No. 99-6-09359

C. L. Ramsey	Clerk I	$ 4.55
E. A. Lanier	Graduate Research Assistant	758.87
D. S. Clifton	Research Scientist	69.10
J. L. Tatom	Prin. Research Engineer	963.00
B. N. Cartledge	Secretary	76.76
J. Jordan	Secretary	5.04
D. K. Brownlee	Clerk III	56.86
N. J. Goodson	Secretary	21.07
J. D. Klose	Clerk-Typist I	15.81
W. E. Sanders	Student Assistant	6.30
	Cash Federal	$ 1,977.36
	Cash Grantee	-
		$ 1,977.36

I.	Project Director	$ 963.00
II.	Research Scientist	69.10
III.	Support Personnel	945.26
		$ 1,977.36

Feb. 20, 1976

Budget Bureau No. 41-R2448; Approval Expires April 30, 1971

Grantee Organization: Georgia Tech Research Institute	Address: Georgia Tech Res. Inst., Ga. Inst. of Tech., Atlanta, Georgia 30332
Grant No.: 99-6-09359	
Report No.: 5 FINAL REPORT	

FORM ED-325 (5-7-68)

U.S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION

FINANCIAL REPORT
TITLE III TECHNICAL ASSISTANCE GRANTS
(Section 301(a) of Public Law 89-136)

IMPORTANT: Prepare this report in **triplicate**. **File within 15 days after the end of the period covered.** Submit original and one copy to:

Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20230

Period Covered
From * 7/1/75
To 1/31/76

*Grantee - Round amounts to nearest whole dollar Budget Category	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	1,977	–		1,977	73,685	27,361		101,046	73,469	25,891	–	99,360	(216)
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	50	–		50	3,324	1,593		4,917	4,000	–	–	4,000	676
(b) Per Diem													
Total Travel	50	–		50	3,324	1,593		4,917	4,000	–	–	4,000	676
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	467	6		473	3,703	704		4,407	3,500	–	–	3,500	(203)
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous													
Total Other Costs	467	6		473	3,703	704		4,407	3,500	–	–	3,500	(203)
6. Costs Not Listed Above: *(Itemize)* (a) Overhead	1,345	–		1,345	47,955	17,784		65,739	47,755	16,829	–	64,584	(200)
(b) Employee Retirement Benefits	(533)	–		(533)	6,259	2,379		8,638	6,246	2,270	–	8,516	(13)
(c) Computer	–	109		109	–	109		109					
(d)													
Total Itemized Costs	812	109		921	54,214	20,272		74,486	54,001	19,099	–	73,100	(213)
TOTALS →	3,306	115		3,421	134,926	49,930		184,856	134,970	44,990	–	179,960	44

*Represents a billing period and not necessarily the time charges were incurred.

USCOMM-DC 30970-P68

Budget Bureau No. 41-R2448; Approval Expires April 30, 1971

Grant No. 99-6-09359

Report No. 3

Address
Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, Georgia 30332

FORM ED-325 (5-7-68)

U.S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION

FINANCIAL REPORT
TITLE III TECHNICAL ASSISTANCE GRANTS
(Section 301(a) of Public Law 89-136)

IMPORTANT: Prepare this report in triplicate. File within 15 days after the end of the period covered. Submit original and one copy to:

Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20230

Period Covered
From 1/1/75
To 3/31/75

*Grantee - Round amounts to nearest whole dollar Budget Category	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	37,506	2,342	-	39,848	61,374	17,457	-	78,831	73,469	25,891	-	99,360	12,095
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	1,140	-	-	1,140	1,722	-	-	1,722	4,000	-	-	4,000	2,278
(b) Per Diem													
Total Travel	1,140	-	-	1,140	1,722	-	-	1,722	4,000	-	-	4,000	2,278
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	1,033	-	-	1,033	2,276	-	-	2,276	3,500	-	-	3,500	1,224
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous													
Total Other Costs	1,033	-	-	1,033	2,276	-	-	2,276	3,500	-	-	3,500	1,224
6. Costs Not Listed Above: *(Itemize)* (a) Overhead	24,379	1,522	-	25,901	39,893	11,346	-	51,239	47,755	16,829	-	64,584	7,862
(b) Employee Retirement Benefits	2,791	196	-	2,987	4,148	1,510	-	5,658	6,246	2,270	-	8,516	2,098
(c)													
(d)													
Total Itemized Costs	27,170	1,718	-	28,888	44,041	12,856	-	56,897	54,001	19,099	-	73,100	9,960
TOTALS →	66,849	4,060	-	70,909	109,413	30,313	-	139,726	134,970	44,990	-	179,960	25,557

PERSONNEL ITEMIZATION (*Round amounts to nearest whole dollar)

Name (1)	Title or Position (2)	Annual Salary (3)	Rate Per Da. Wk. Mo. (4)	Time Worked This Period Das. Wks. Mos. (5)	Expenditures This Period: Cash Federal (6)	Cash Grantee (7)	In-Kind Grantee (8)	Total Expenditures This Period (9)
TOTAL →	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

George R. Brock - Accountant I
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen - Contracting Officer
(Director of Grantee Organization)

(Signature) *(Date)*

(Signature) *(Date)*

FORM ED-325 (5-7-68) USCOMM-DC 30970-P68

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistant Secretary
Washington, D. C. 20230

April 25, 19 75

Project No A-1644

Period 1/1/75 to 3/31/75

PERSONNEL ITEMIZATION
Grant No. 99-6-09359

NAME	POSITION OR TITLE	AMOUNT
J. D. Klose	Clerk-Typist I	$ 11.69
D. A. Burch	Secretary II	29.78
T. D. Harris	Co-op Student	16.80
P. H. Har-oz	Asst. Research Engineer	3,195.72
P. D. Koos	Research Scientist	972.27
R. E. Collier	Sr. Research Scientist	2,218.01
W. C. Howard	Sr. Research Scientist	20.55
D. W. Black	Secretary I	286.40
D. S. Clifton	Research Scientist	1,578.33
J. W. Tatom	Prin. Research Engineer	6,548.40
E. D. Hancock	Secretary II	1,635.90
D. R. Hurst	Chem. Tech. III	42.85
M. F. Munoz	Sr. Research Engineer	3,663.76
J. H. Murphy	Sr. Research Engineer	5,663.16
J. M. Akridge	Sr. Research Engineer	5,055.76
S. T. Alford	Sr. Research Engineer	107.00
J. F. Kinney	Sr. Research Engineer	1,970.59
C. H. Bonham	Research Engineer	321.00
P. D. Kisselburg	Secretary II	22.98
W. H. Hicklin	Research Engineer	954.72
R. R. Sheppard	Asst. Research Engineer	374.50
S. D. Marshall	Secretary I	275.63
W. C. Darley	Research Engineer	1,444.04
H. G. Dean	Prin. Research Engineer	1,016.50
P. S. Reichert	Secretary I	12.68
M.P. Cole	Clerk II	21.59
G. A. Parets	Research Engineer	148.46
B. J. Smith	Secretary I	61.26
W. C. Ward	Sr. Research Scientist	206.42
C. C. Wommack	Research Scientist	137.76
M. L. Brown	Chem. Tech. I	132.04
J. K. Hendrix	Chem. Tech. III	169.51
A. R. Colcord	Sr. Research Engineer	181.45
M. L. Herod	Secretary I	37.28
R. J. Barker	Secretary I	16.47
N. J. Goodson	Clerk III	19.16
W. N. Craig	Asst. Research Engineer	473.47
L. R. Edens	Research Engineer	64.60
A. H. Anglyn	Student Assistant	2.14

(Continued)

	Title of Position	Annual Salary	Rate Per Da. Wk. Mo.	Time Worked This Period Das. Wks. Mos.	Cash Federal	Cash Grantee	In-Kind Grantee	Total Expenditures This Period
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TOTAL →	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

George R. Brock - Accountant I
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen - Sr. Grants and Contracts Officer
(Director of Grantee Organization)

(Signature) 4/28/75 (Date)

(Signature) (Date)

FORM ED-325 (5-7-68) USCOMM-DC 30970-P68

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistant Secretary
Washington, D. C. 20230

August 20, 19 75
Project No. A-1644
Period 4/1/75 to 6/30/75

PERSONNEL ITEMIZATION
Grant No. 99-6-09359

C. L. Ramsey	Clerk I	$ 79.30
R. E. Collier	Sr. Research Scientist	709.76
D. S. Clifton	Research Scientist	2,078.65
E. D. Hancock	Secretary II	1,389.85
J. H. Murphy	Sr. Research Engineer	3,123.06
J. M. Akridge	Sr. Research Engineer	1,966.13
P. H. Har-oz	Asst. Research Engineer	911.28
W. C. Darley	Research Engineer	366.29
J. W. Tatom	Prin. Research Engineer	2,732.52
L. R. Edens	Research Engineer	75.12
F. Kingsland	Research Engineer	2,053.87
B. J. Smith	Secretary I	183.76
P. W. Potts	Research Scientist	103.07
W. T. Studstill	Research Engineer	829.97
R. L. Tessner	Research Engineer	67.61
E. L. Lewis	Asst. Research Engineer	61.53
J. L. Hughey	Secretary I	27.82
W. N. Craig	Asst. Research Engineer	65.76
M. F. Munoz	Sr. Research Engineer	682.12
G. K. Webb	Artist	55.96
S. Carson	Secretary I	115.50
D. W. Black	Secretary I	449.50
M. L. Herod	Secretary I	12.43
D. A. Arfail	Secretary III	22.05
H. G. Dean	Prin. Research Engineer	802.50
W. H. Hicklin	Research Engineer	112.32
N. J. Goodson	Clerk III	202.99
S. D. Marshall	Secretary I	110.25
J. D. Klose	Clerk-Typist I	57.07
A. H. Anglyn	Student Assistant	.71
E. A. Lanier	Graduate Research Assistant	394.88
R. J. Barker	Secretary I	79.61
D. K. Brownlee	Secretary I	134.26
L. W. Hurd	Clerk-Typist I	131.71
S. G. Daniell	Asst. Research Scientist	48.79
		20,238.00
	Cash Federal	10,334.02
	Cash Grantee	9,903.98
		$ 20,238.00

I. Project Director	$ 2,732.52
II. Res. Scientists & Res. Engrs.	14,087.83
III. Support Personnel	3,447.65
	$ 20,238.00

Grant No.	Ga. Inst. of Tech.	ECONOMIC DEVELOPMENT ADMINISTRATION	File within 15 days after the end of the period covered. Submit original and one copy to:	From
99-6-09359	Atlanta, Ga. 30332	FINANCIAL REPORT TITLE III TECHNICAL ASSISTANCE GRANTS *(Section 301(a) of Public Law 89-136)*	Office of Technical Assistance Economic Development Administration U. S. Department of Commerce Washington, D. C. 20230	4/1/75
Report No. 4				To 6/30/75

*Grantee - Round amounts to nearest whole dollar	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
Budget Category	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	10,334	9,904	-	20,238	71,708	27,361	-	99,069	73,469	25,891	-	99,360	1,761
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	1,552	1,593	-	3,145	3,274	1,593	-	4,867	4,000	-	-	4,000	726
(b) Per Diem													
Total Travel	1,552	1,593	-	3,145	3,274	1,593	-	4,867	4,000	-	-	4,000	726
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	960	698	-	1,658	3,236	698	-	3,934	3,500	-	-	3,500	264
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous													
Total Other Costs	960	698	-	1,658	3,236	698	-	3,934	3,500	-	-	3,500	264
6. Costs Not Listed Above: *(Itemize)* (a) Overhead	6,717	6,438	-	13,155	46,610	17,784	-	64,394	47,755	16,829	-	64,584	1,145
(b) Employee Ret. Benefits	2,644	869	-	3,513	6,792	2,379	-	9,171	6,246	2,270	-	8,516	(546)
(c)													
(d)													
Total Itemized Costs	9,361	7,307	-	16,668	53,402	20,163	-	73,565	54,001	19,099	-	73,100	599
TOTALS →	22,207	19,502	-	41,709	131,620	49,815	-	181,435	134,970	44,990	-	179,960	3,350

	(2)	(3)	Da. Wk. Mo. (4)	Das. Wks. Mos. (5)	Federal (6)	Grantee (7)	Grantee (8)	This Period (9)
TOTAL →	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

George R. Brock - Accountant I
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen - Sr. Grants and Contracts Officer
(Director of Grantee Organization)

(Signature) 8/25/75 (Date)

(Signature) (Date)

FORM ED-325 (5-7-68) USCOMM-DC 30970-P68

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistance Secretary
Washington, D. C. 20230

July 16, 19 76

Project No. A-1644

Period 2/1/76 to 6/30/76

PERSONNEL ITEMIZATION
Grant No. 99-6-09359-1

C. Soora	Asst. Res. Scientist	$ 1,608.32
G. B. Curtis	Sr. Research Engineer	3,366.03
M. F. Munoz	Sr. Research Engineer	71.42
R. G. Pearl	Research Engineer	1,185.91
D. I. Wilmer	Asst. Research Engineer	803.38
H. A. Gibson	Secretary I	20.46
B. S. Wilkerson	Secretary I	2.71
J. L. Birchfield	Sr. Research Engineer	2,254.49
R. H. Fulford	Research Engineer	2,798.50
C. P. Hayth	Student Assistant	331.20
L. J. Brown	Clerk Typist III	11.82
D. K. Brownlee	Clerk Typist III	12.30
C. L. Penn	Secretary	2.71
W. C. Darley	Research Engineer	888.09
W. T. Studstill	Research Engineer	643.36
S. L. Dudley	Research Scientist	207.54
R. L. Hughey	Research Engineer	989.73
W. N. Craig	Research Engineer	67.41
L. R. Edens	Research Engineer	75.97
B. E. James	Sr. Research Engineer	109.68
E. L. Lewis	Asst. Research Engineer	62.06
R. L. Tessner	Research Engineer	76.40
		$15,589.49

Cash Federal	$12,540.55
Cash Grantee	3,048.94
	$15,589.49

I.	Project Directors	$ 2,366.17
II.	Research Scientist & Research Engineers	10,370.36
III.	Support Personnel	2,854.96
		$15,589.49

...anta, Georgia 30332

99-6-09359-1

Report No.
6

FINANCIAL REPORT
TITLE III TECHNICAL ASSISTANCE GRANTS
(Section 301(a) of Public Law 89-136)

Office of Technical Assistance
Economic Development Administration
U. S. Department of Commerce
Washington, D. C. 20230

2/1/76
To
6/30/76

*Grantee - Round amounts to nearest whole dollar	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash
Budget Category	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	Unexpended (9) less (5) (13)
1. Personnel: (List on Back) Total Personnel	12,541	3,049		15,590	86,226	30,410		116,636	121,635	42,835		164,470	35,409
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	699			699	4,023	1,593		5,616	9,000			9,000	4,977
(b) Per Diem													
Total Travel	699			699	4,023	1,593		5,616	9,000			9,000	4,977
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	324			324	4,027	704		4,731	7,500			7,500	3,473
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous									4,000	4,000		8,000	4,000
Total Other Costs	324			324	4,027	704		4,731	11,500	4,000		15,500	7,473
6. Costs Not Listed Above: (Itemize) (a) Overhead	8,528	2,073		10,601	56,483	19,857		76,340	78,238	28,351		106,589	21,755
(b) Employee Retirement Benefits	720	272		992	6,979	2,651		9,630	13,621	3,812		17,433	6,642
(c) Computer						109		109					
(d)													
Total Itemized Costs	9,248	2,345		11,593	63,462	22,617		86,079	91,859	32,163		124,022	28,397
TOTALS →	22,812	5,394		28,206	157,738	55,324		213,062	233,994	78,998		312,992	76,256

USCOMM-DC 33370-P68

PERSONNEL ITEMIZATION (*Round amounts to nearest whole dollar)

Name (1)	Title or Position (2)	Annual Salary (3)	Rate Per Da. Wk. Mo. (4)	Time Worked This Period Das. Wks. Mos. (5)	Expenditures This Period: Cash Federal (6)	Expenditures This Period: Cash Grantee (7)	Expenditures This Period: In-Kind Grantee (8)	Total Expenditures This Period (9)
TOTAL →	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

Gedney L. Vining, ACCOUNTANT II
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen, Contracting Officer
(Director of Grantee Organization)

(Signature) 7/21/76 (Date)

(Signature)

FORM ED-325 (5-7-68)

IN ACCOUNT WITH

GEORGIA TECH RESEARCH INSTITUTE

Administration Building

GEORGIA INSTITUTE OF TECHNOLOGY

ATLANTA, GEORGIA 30332

TO: U. S. Department of Commerce
Economic Development Administration
Office of the Assistance Secretary
Washington, D. C. 20230

October 26, 1976

Project No. A-1644

Period 7/1/76 to 9/30/76

PERSONNEL ITEMIZATION

Grant No. 99-6-09359-1

Name	Position or Title	Amount
S. D. Marshall	Secretary I	$ 43.97
G. Soora	Assistant Research Scientist	1,757.47
G. B. Curtis	Senior Research Engineer	4,123.95
R. G. Pearl	Research Engineer	1,744.98
D. I. Wilmer	Assistant Research Engineer	1,129.92
J. L. Birchfield	Senior Research Engineer	345.08
R. H. Fulford	Research Engineer	2,667.85
L. J. Brown	Clerk Typist III	11.27
C. L. Penn	Secretary I	28.96
W. C. Darley	Research Engineer	814.08
W. T. Studstill	Research Engineer	742.04
R. L. Hughey	Research Engineer	824.79
L. R. Edens	Research Engineer	63.31
H. S. Eggert	Secretary II	315.00
K. L. Huey	Clerk Typist I	27.78
R. A. Hinton	Clerk Typist I	30.60
C. L. Ramsey	Clerk I	17.81
M. M. Murphy	Student Assistant	384.00
A. Wu	Clerk Typist II	28.96
L. B. Mazur	Clerk III	37.92
S. B. Clark	Secretary II	170.65
J. M. Poteat	Student Assistant	28.70
K. B. Hill	Secretary I	1.86
		$15,340.95
	Cash Federal	15,340.95
	Cash Grantee	-0-
		$15,340.95

I.	Project Directors	$ 345.08
II.	Research Scientist and Research Engineers	13,868.39
III.	Support Personnel	1,127.48
		$15,340.95

Budget Bureau No. 41-R2448; Approval Expires April 30, 1971

Grantee Organization	Address	FORM ED-325 (5-7-68)	IMPORTANT	Period Covered
Georgia Tech Research Institute	Georgia Tech Research Institute Georgia Institute of Technology Atlanta, Georgia 30332	U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION **FINANCIAL REPORT** **TITLE III TECHNICAL ASSISTANCE GRANTS** *(Section 301(a) of Public Law 89-136)*	Prepare this report in triplicate. File within 15 days after the end of the period covered. Submit original and one copy to: Office of Technical Assistance Economic Development Administration U. S. Department of Commerce Washington, D. C. 20230	From 7/1/76 To 9/30/76
Grant No. 99-6-09359-1				
Report No. 7				

*Grantee - Round amounts to nearest whole dollar Budget Category	Expenditures this Period				Expenditures to Date				Total Authorized Budget				Federal Cash Unexpended (9) less (5)
	Cash Federal (1)	Cash Grantee (2)	In-Kind Grantee (3)	Total (4)	Cash Federal (5)	Cash Grantee (6)	In-Kind Grantee (7)	Total (8)	Cash Federal (9)	Cash Grantee (10)	In-Kind Grantee (11)	Total Budget (12)	(13)
1. Personnel: *(List on Back)* Total Personnel	15,341			15,341	101,567	30,410		131,977	121,635	42,835		164,470	20,068
2. Consultant and Contract Services: (a) Consultants													
(b) Contract Services													
Total Consultants and Contracts													
3. Travel: (a) Transportation	946			946	4,969	1,593		6,562	9,000			9,000	4,031
(b) Per Diem													
Total Travel	946			946	4,969	1,593		6,562	9,000			9,000	4,031
4. Space Costs and Rentals: (a) Space (Rent or Use)													
(b) Office Equipment (Rent or Use)													
(c) Office Furniture (Rent or Use)													
Total Space and Rentals													
5. Other Costs: (a) Consumable Supplies	1,960			1,960	5,987	704		6,691	7,500			7,500	1,513
(b) Postage													
(c) Printing and Publications													
(d) Telephone and Telegraph													
(e) Utilities													
(f) Personnel Burden													
(g) Miscellaneous									4,000	4,000		8,000	4,000
Total Other Costs	1,960			1,960	5,987	704		6,691	11,500	4,000		15,000	5,513
6. Costs Not Listed Above: *(Itemize)* (a) Overhead	10,432			10,432	66,915	19,857		86,772	78,238	28,351		106,589	11,323
(b) Employee Retirement Benefits	1,089			1,089	8,068	2,651		10,719	13,621	3,812		17,433	5,553
(c) Computer						109		109					
(d)													
Total Itemized Costs	11,521			11,521	74,983	22,617		97,600	91,859	32,163		124,022	16,876
TOTALS →	29,768			29,768	187,506	55,324		242,830	233,994	78,998		312,992	46,488

PERSONNEL ITEMIZATION (*Round amounts to nearest whole dollar)

Name (1)	Title or Position (2)	Annual Salary (3)	Rate Per Da. Wk. Mo. (4)	Time Worked This Period Das. Wks. Mos. (5)	Expenditures This Period: Cash Federal (6)	Cash Grantee (7)	In-Kind Grantee (8)	Total Expenditures This Period (9)
TOTAL →	If more space than is provided on this form is needed for any item, please add continuation sheet using format appropriate to the item being continued.							

Remarks: * Cite authorizing document for any differences in the budgeted amount(s) of this report (line items or totals) from those submitted in the last report. **List any Consultant(s) and/or Contract Services for current period. Give names, addresses, period of service, what services, etc. For Consultants, enter full information according to the format given above under "Personnel Itemization."

I hereby certify that this financial report is true to the best of my knowledge, that all expenditures have been made solely for the purposes set forth in the Grant Agreement as approved by the Economic Development Administration, and that to the best of my information and belief the values listed for the contributions in-kind (if any) are fair and reasonable.

Gedney L. Vining, Accountant II
(Name and Title of Person Preparing Financial Report)

Dwight L. Allen, Contracting Officer
(Director of Grantee Organization)

(Signature) *(Date)*

(Signature) *(Date)*

FORM ED-325 (5-7-68)

DRAFT

A PROGRAM TO ASSIST BUSINESS AND INDUSTRY IN COPING WITH THE ENERGY CRISIS

A Report to the Economic Development
Administration Office of Technical Assistance
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by

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SUMMARY

This report describes work accomplished in the period June 10, 1974 - August 31, 1975 under EDA grant 99-6-09359. The report concerns a program of data collection from and technical assistance to Georgia industry, the concern being determining and improving the utilization of energy. The program had several objectives:

- the determination of energy profiles for Georgia industry
- evaluation of the potential of energy conservation practices in industry
- technical assistance to plants participating in the program
- the dissemination of energy conservation information through a series of conferences and workshops held throughout the state.

To accomplish these objectives, the program was organized into three work areas, e.g.:

- A mail survey to collect extensive energy consumption data from a large sample of Georgia industry
- An energy audit-site visit program to collect intensive data on both energy consumption and energy conservation potentials from the 23 most energy consuming Georgia industries and to provide technical in-plant assistance
- A series of conferences and workshops to expand the reach of the site visit technical assistance program.

The mail survey, conducted under the auspices of the State Energy Office involved 2,333 companies of which 1,211 responded and from which 733 returned useable questionnaires. Data collected from this survey included energy parameters such as the energy use per employee and the energy use per dollar output. In addition, detailed information on the utilization of energy within the plants, the energy use for transportation; the costs of the energy and the fuel storage capacities were determined. Significant reported differences within a given industry between the various energy parameters were observed.

The energy audit-site visit program involved 46 full day visits of a team of four engineers to plants within 23 three digit SIC industries. These visits provided intensive measured data on the energy flow and utilization within the plant and thus provided a back-up to the mail survey, besides producing information on the amounts of energy wasted, which the mail survey could not provide. During these visits suggestions as to improvements in the plant operation to save energy were also made to the plant supervision.

The Conference/Workshop program involved a total of 8 broad based, management oriented, four hour conferences followed by 8 indepth, all-day technical workshops. This program involved a total of 230 attendees and the participation of numerous individuals from the Engineering Experiment Station, the State Energy Office, the various Area and Planning and Development Commisssions, local chambers of commerce and also from the industries themselves.

The study has provided an indepth knowledge of how energy is used within Georgia industry and has allowed means of estimating the potential savings from energy conservation practices. Likewise it has provided technical assistance to many plants and initiated a growing awareness of the importance of energy conservation practices. In addition the technical assistance methodology developed during this program should provide a valuable basis for parallel work in other states.

From this work it appears that energy costs frequently represent a very small fraction of the value added and thus the incentive to save energy is often very small. The significant variations in the separate energy parameters encountered in the study suggest that broad generalizations about individual industry energy consumption parameters may be unwise or even dangerous. Also it appears that much better internal energy accounting methods are needed; perhaps legislation which would require individual meters on large energy consuming components is indicated.

Further, the need to sustain and increase the awareness of Georgia industry regarding efficient energy utilization appears critically important. Demonstration programs and technical assistance not only for Georgia but also its neighboring states is also indicated.

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I. INTRODUCTION

The efficient utilization of energy within the industrial sector represents an important national interest in these days of short fuel supplies and high energy costs. The national interest also requires that our businesses and industries remain viable and strong. The vital and complex interrelationships between the various producers and users of industrial products has vividly illustrated that the energy crisis leaves no industry unaffected. Too frequently plants without direct energy supply problems have faced shut down or unreasonable costs due to their dependence upon other plants that have fuel difficulties. Thus the manufacturer today must not only be concerned with minimizing his own direct energy needs, he must make every effort to not be dependent upon energy intensive raw materials or at least be prepared with alternative materials should his primary supplies be cut off.

These considerations, coupled with a widespread and historical indifference to energy costs and to energy accounting methods, have confronted the industrialist, especially the operator of small to medium size plants, with a new and profound set of problems at a time when business is depressed and capital costs are high. Many members of the industrial and business community are not well equipped to cope with these problems effectively. Unless these problems are overcome, the prospects for the future are not good and the implications for Georgia and our nation's economic growth are severe.

It is, then, within this context that the present work has been conducted. It is hoped that the results of this work will be useful in assisting Georgia industry in understanding and solving its energy problems. Likewise, it is hoped that benefits can be derived from a national perspective in the recognition of the problems encountered in the study and through application of the methodology utilized.

The program grew out of an unsolicited proposal submitted to the Economic Development Commission in late 1973 for a "crash program" for energy assistance to small business and industry. However, the oil embargo of the winter of 1973-1974 had ended by the time the program got underway and the emphasis was changed to the long term energy problems facing Georgia industry. As such the program had several objectives, which included:

(1) the determination of energy profiles for Georgia industry. (Which industries use which fuels, to what extent and how efficiently?)

(2) evaluation of the potential of energy conservation practices in industry

(3) technical assistance to plants participating in the study

(4) the dissemination of energy conservation information through a series of public conferences and workshops held throughout the state.

This report describes the work accomplished in these four areas and the techniques used in collecting, and analyzing the raw data. The report also discusses the problems associated with obtaining valid data and the dangers encountered in using data derived from too limited a source. Indeed, after considering our experiences there is some question as to the validity of data listed in many recognized information sources when the implications of the wide range of values encountered about the "mean" are recognized. Too frequently, the fact that wide differences exist between individual plant characteristics have been ignored and the resulting complexities avoided through use of average values.

One basic operating condition in the project has been the breakdown of the industries investigated into three digit SIC categories. Clearly, a two digit breakdown would be too broad and a four digit breakdown too narrow. However, even with the three digit breakdown, there were many problems in correlating the data because of the wide differences in energy utilization often encountered between individual plant activities and due to large variations in efficiency between plants having the same activity.

The program has operated in several work areas and has involved the efforts of dozens of individuals at the Engineering Experiment Station, the State Energy Office, local chambers of Commerce, numerous city colleges, and Area Planning and Development Commissions all over the State. The coordination, itself, has been a major activity in the program since so many different skills and sectors have been required.

Because it was important that the project actually produce results that would also be useful to individual small industrialists, an external advisory committee with members chosen from industry and government was organized to monitor and advise in the conduct of the study. This group provided the project with a more "down to earth" approach than might otherwise have been followed and made many other useful contributions for which we are deeply indebted.

In the following chapters, descriptions of the various activities designed to meet the project objectives are presented.

II. METHODOLOGY USED IN ENERGY PROGRAM

The program work plan shown in Figure 1 was constructed during the early conceptualization of the energy program. This plan outlines the general tasks necessary to accomplish the objectives of the program and is a fair representation, with minor revisions, of the actual development and progress of the program. As can be seen, the emphasis in the work plan was evenly divided between research and implementation.

The research phase of the energy program involved the collection of data, both secondary and primary, and the analysis of the data. Secondary sources of data were utilized to provide project personnel with the latest available information on such topics as industry energy consumption, energy surveys, energy conservation, etc. Selected references which proved useful are listed in the bibliography.

Although the secondary data sources did provide much useful information, primary data collection was necessary in order to obtain the data needed to accomplish the research objectives. Primary data collection basically involved two distinct and separate efforts: energy consumption data and energy conservation data. Because of the complexity of the information required and the necessity of technical expertise required to answer the questions, plant energy audits were used to collect data on energy efficiency, costs and conservation potential. A mail survey conducted through the auspicies of the State Energy Office was used to collect general information on energy consumption and costs from firms in the manufacturing sector. The survey instruments, sample designs, and procedures developed as well as the rationale behind the choice of survey techniques is discussed in the following sections.

THE IN-PLANT ENERGY AUDIT PROGRAM

In-plant interviews were utilized to identify and examine energy usage, the efficiency of energy use, energy costs and especially the potential for energy conservation. An energy audit team which usually consisted of four engineers visited each of the selected plants and spent the entire day in an in-depth examination of energy use. The general procedure used in the in-plant audit was as follows: First, the team met with the plant's management to discuss the objectives of the visit and the type of information required; this was followed by a tour of the plant's facilities during which energy using equipment and processes were identified; based on this preliminary survey as well as the plant management's input the team then ranked the identified processes according to potential for energy conservation; an analysis was conducted and measurements of efficiencies were made; finally, data on energy consumption and costs were collected. Before leaving the plant the audit team met with management to relate their preliminary findings and after an in-depth analysis of the data, a letter report was sent to the firm interviewed with recommendations and suggestions for energy conservation.

Unfortunately, it would be almost impossible to conduct the in-plant audits and gather the extensive data required from a sufficient number of plants so that the results would meet rigorous statistical tests. Therefore, based on an

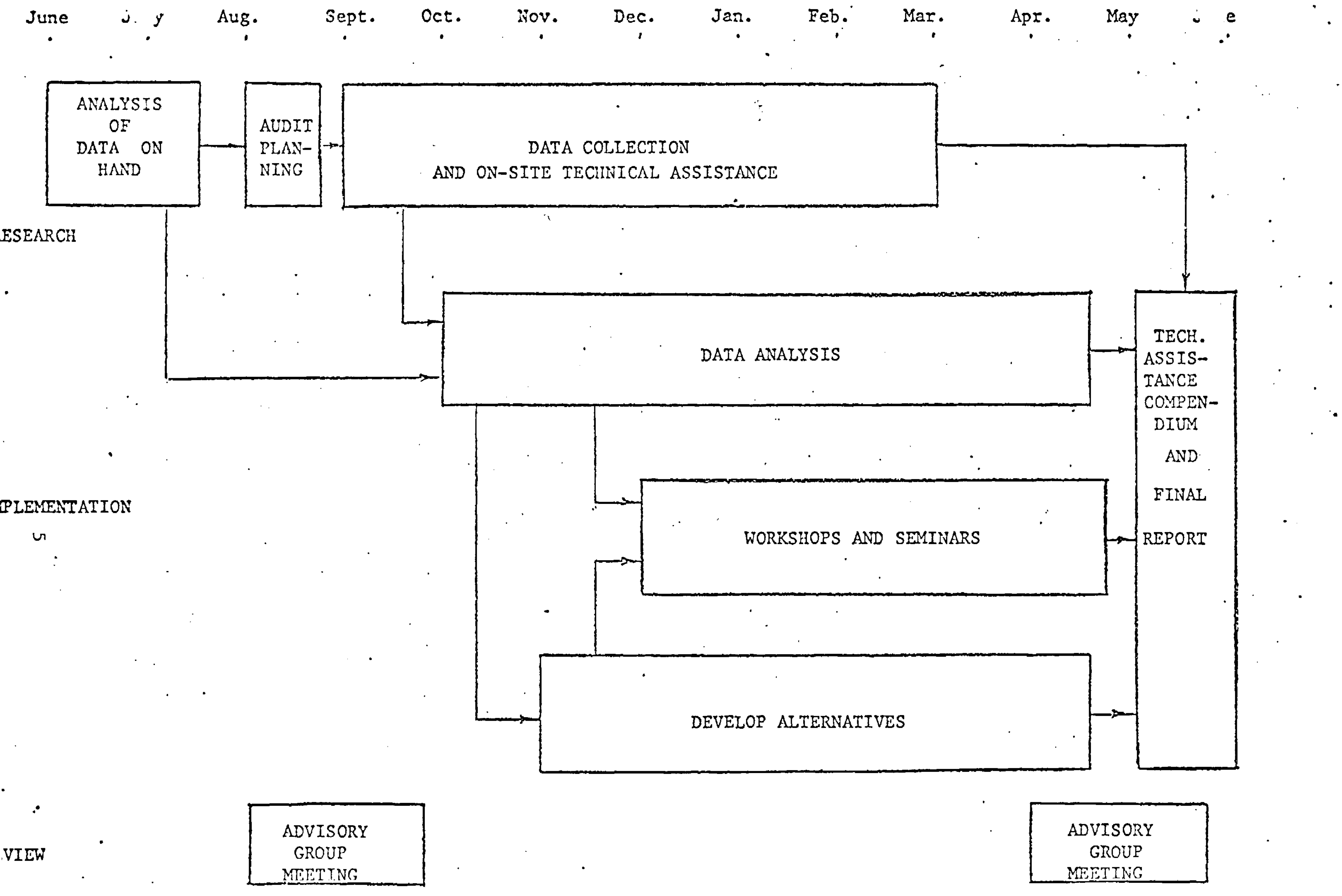

Figure 1. Program Work Plan

energy consumption criteria, certain industries in the Georgia manufacturing sector were selected. Within these industries an attempt was made to select a 5% sample which contained plants which were representative of the industry. The data gathered is then presented in a case study format of a representative firm for that industry. This concept of a "representative firm" within an industry is recognized as a subject of valid criticism as pointed out by Salter.[1]

The availability of data on the energy consumption of the manufacturing sector of Georgia upon which to base the selection of industries to be interviewed is limited. The 1971 Census of Manufacturers has some energy consumption data but mostly at the two-digit standard industrial classification level. In order to identify the large energy users in this sector, it was assumed that the state of technology was approximately the same in Georgia as the nation and the following procedure based on national energy data was used.

The identification of those industry groups to be contacted during the energy audit was accomplished using criteria based on the following three indicators: total energy used, natural gas used and fuel oil used. The energy indicators were calculated for each three-digit industry group in the state by the multiplication of the national industry's ratio of energy used per employee by the employment of the industry in Georgia. These energy measures identified those industry groups which consumed large amounts of energy in the state during 1971 (see Table 1).

Of equal significance to the identification of large energy users in the study of policy aspects of energy consumption patterns within the state are those industries which are important to the states' economy in terms of employment and value added by manufacture. These indices provide a measure of the economic importance of the large energy users to Georgia as shown in Table 1.

In order for an industry group to be involved in the energy audit, it had to meet one of the following criteria:

- the industry group accounted for more than 1% of total energy used in the state
- the industry group accounted for more than 1% of fuel oil used in the state
- the industry group accounted for more than 1% of natural gas used in the state.

Twenty-seven three-digit industry groups were identified which met one of the above criteria. These industry groups accounted for over 84% of the total

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[1]Salter, W. E. G., Productivity and Technical Change, Monograph 6, London, Cambridge University Press 1960.

energy used, 91% of the total fuel oil used, 87% of the total natural gas used, 50% of the total value added by manufacture, and 52% of the total employment in the state in the manufacturing sector.

Shown in Table 2 are the industry groups selected for personal site interviews ranked by their precentage of the total energy consumed in the manufacturing sector. Also displayed are the number of firms by employment size category and the number of site visits for each industry group. In general, a five percent sample was chosen from each three-digit SIC industry group with a minimum of one visit per category. In selecting the representive firms for the industry groups, attention was given to the distribution of firms by employment size class and distribution of firms within each industry category at the four-digit SIC level. Those firms with less than 20 employers were eliminated from the survey. For SIC 204, 229, 241, 242, 203, and 264 industry groups, no plants were surveyed due to scheduling problems such as the difficulty of obtaining management approval for the in-plant visit. Additional plants were selected for visits in the following industry catagories to ensure that a representative view of energy consumption within the industry category would be obtained: SIC 227, 201, 371, and 222. Requests for energy technical assistance originated from the following industry groups: 224, 295, and 363 and these industries were included in the energy audit site visits.

The survey instruments which were developed and used during the in-plant energy audits are in Appendix A. Basically, there are two sets of questionnaires: one designed to collect energy consumption data and the other to be used in the determination of energy conservation potential.

ENERGY CONSUMPTION MAIL SURVEY

Data on the 1973 energy consumption patterns of the industry groups, which comprise the Georgia manufacturing section, was collected. With this information, combined with the data collected during the in-plant energy audit, an approximation of the possible energy conservation within the manufacturing section can be estimated. Since a large sample was necessary to obtain energy consumption data which would have any degree of precision and reliability, a mail survey was conducted. The survey instrument was developed at the Engineering Experiment Station but was conducted by the State Energy Office.

The Georgia Department of Labor furnished their 1975 mailing list for the manufacturing sector. Information, such as the standard deviations of the desired parameters which would have allowed the calculation of the sample size for each of the industry groups was not available. The precentage of firms sampled in an industry group varied depending on the total number of firms within the group. Shown in Table 3 are the sampling percentages used for the different size industry groups. For example, if the three-digit SIC industry group contained less than 5 firms, because of confidentiality requirements, no survey was conducted. However, if the industry group contained between 5-24 firms all the firms received the questionnaire.

Simple random sampling was the method used to select the firms to be surveyed out of each industry group. Three mailings were conducted along with telephone calls to obtain additional information for partially completed questionnaires. The Georgia State Energy Office handled the mechanics of the mail survey, that is, the mailing of the questionnaires, telephone interviews and coding of the responses for keypunching. The mail questionnaire developed as well as the informational letter are included in Appendix B. Although the questionnaire was field-tested to insure its readibility, certain problems were encountered and are discussed in the section on energy use within the Georgia manufacturing sector.

The expansion factor by which the sample total was multiplied to obtain an estimate of a population characteristic was based on employment. It would have been better to base the expansion factor on a variable such as sales revenue which would have been more closely related to output; unfortunately, this was not possible because sales revenue information is not available at the three-digit SIC level for the statistical universe.

The Statistical Package for the Social Sciences (SPSS)[2], which is a system of computer programs designed to perform statistical analyses on a large data base, was used to calculate the statistical parameters presented in the study.

ESTIMATION OF POTENTIAL ENERGY CONSERVATION

In the process of estimating the industry energy conservation potential, a straightforward series of computations were made. However, the energy conservation potential could not be determined from the mail survey because it required detailed measurements and other information regarding energy discharges from the various plants. The scope of this assessment was accordingly limited to those industries included in the In-Plant Energy Audit Program.

The first step was to classify various processes as either thermal or electrical. This classification was often not as straightforward as it might appear since frequently components contain a complex arrangement of both thermal and electrical processes. Next the percent of the total thermal or electrical energy which each process consumed was determined. Then potential improvements in the various processes were identified and corresponding energy savings determined or estimated. This estimate was derived from several areas; ideas picked up from the plant managers themselves, the various engineers involved in the study, from the literature and also from feedback during the series of conferences and workshops.

The process utilization data was weighted to account for the size of the plant visited and the total number and size of four digit SIC plants to get appropriate three digit process utilization results. Then using three digit energy consumption data obtained from the mail survey, and the identified

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[2]Nie, Norman H. and Dale H. Bent and C. Hadlai Hull, SPSS Statistical Package for the Social Sciences, New York: McGraw-Hill Book Company, 1970.

process improvements, the energy savings were calculated for each process for each industry. These results were summed and the savings for each industry and the Georgia total were determined. A further discussion of this procedure is presented in Section V along with the results of the study.

ENERGY CONSERVATION CONFERENCES AND TECHNICAL WORKSHOPS

In addition to technical assistance provided during the in-plant energy audit, it was planned that the delivery of information developed during the program on practices and techniques of conserving energy should be presented through conferences and workshops. Two types of training programs were conceptualized.

The first program, the In-Plant Energy Conservation and Management Conference, was designed to create an awareness and motivation on the part of industrial managers relative to the profit advantages of energy conservation. This conference was held in eight locations throughout the state and involved a four hour presentation and work period.

The second program, the In-Plant Energy Conservation Technical Workshop, was developed specifically to train technical personnel and plant operating personnel to analyze their situation with respect to energy costs and availability, and to give them direct help in establishing in-plant energy conservation programs. These programs were also held in eight locations but were designed as eight hour instruction and workshop activities.

III. AN OVERVIEW OF ENERGY USE IN GEORGIA

Before the energy consumption patterns in the manufacturing sector are examined in-depth, an overview of the 1973 energy consumption for the entire state will help place the use of energy in the manufacturing sector in proper perspective. In addition, by analyzing the energy flows for Georgia, insight can be gained into the role of energy in the growth and development of the state. A recent publication by the State Energy Office[3] contains information on the states' energy consumption in 1973 and thus provides the main source of data in this discussion.

The primary fuel consumption by economic sectors in Georgia is shown in Table 4. The fuel consumption pattern for the entire state indicates heaviest reliance on petroleum (48.2%) followed by natural gas (28.7%); coal; (20.6%) and hydroelectric power (2.5%). As can be seen, there is a significant difference between sectors in the relative dependence on types of fuel resources. The industrial sector was very dependent on natural gas with over 73% of the sectors' energy needs being supplied by this fuel source. For many cases, natural gas is required for plant processing and, other than propane, there is no substitute. The pattern of energy use in the residential-commercial sector closely parallels gas (74%). The pattern of energy consumption in the transportation sector is particularly dramatic because of its reliance on petroleum (98%). This is a typical pattern for the South where inhabitants depend primarily on private vehicles for traveling to and from work due to the lack of mass transit systems and due to the Souths' development pattern which has led to substantial travel distances between place of work and place of residence. The pattern of fuel resource used for the generation of electric power indicates a reliance on coal (69.5%), petroleum (11.6%), natural gas (10.0%), and hydroelectric (8.9%).

Shown in Table 5 is the distribution of consumption of fuel resources by economic sector in Georgia for 1973. The transportation sector consumed 37.7% of all fuel resources followed by electric generation (28.3%), industrial (19.5%), and residential-commercial (14.5%). The information presented in Table 5 which is most striking is the concentration of a fuel resource use within a single sector. The impact on Georgia's energy consumption sectors of external events such as the coal strike in 1974, the Arab Oil Embargo, and the decreasing supply of natural gas along with associated curtailments can be seen much clearer with the data presented in Table 5. Almost the entire amount of coal (95.7%) brought into the state is used in the generation of electric power. About 77% of the petroleum consumed in the state was in the transportation sector. The industrial sector (50.3%) and residential-commercial (37.5%) are both heavy consumers of natural gas. All the hydroelectric power generated is used by the electric generation sector. Figure 2 is a graphic representation of the flow of energy from source to consumption sector.

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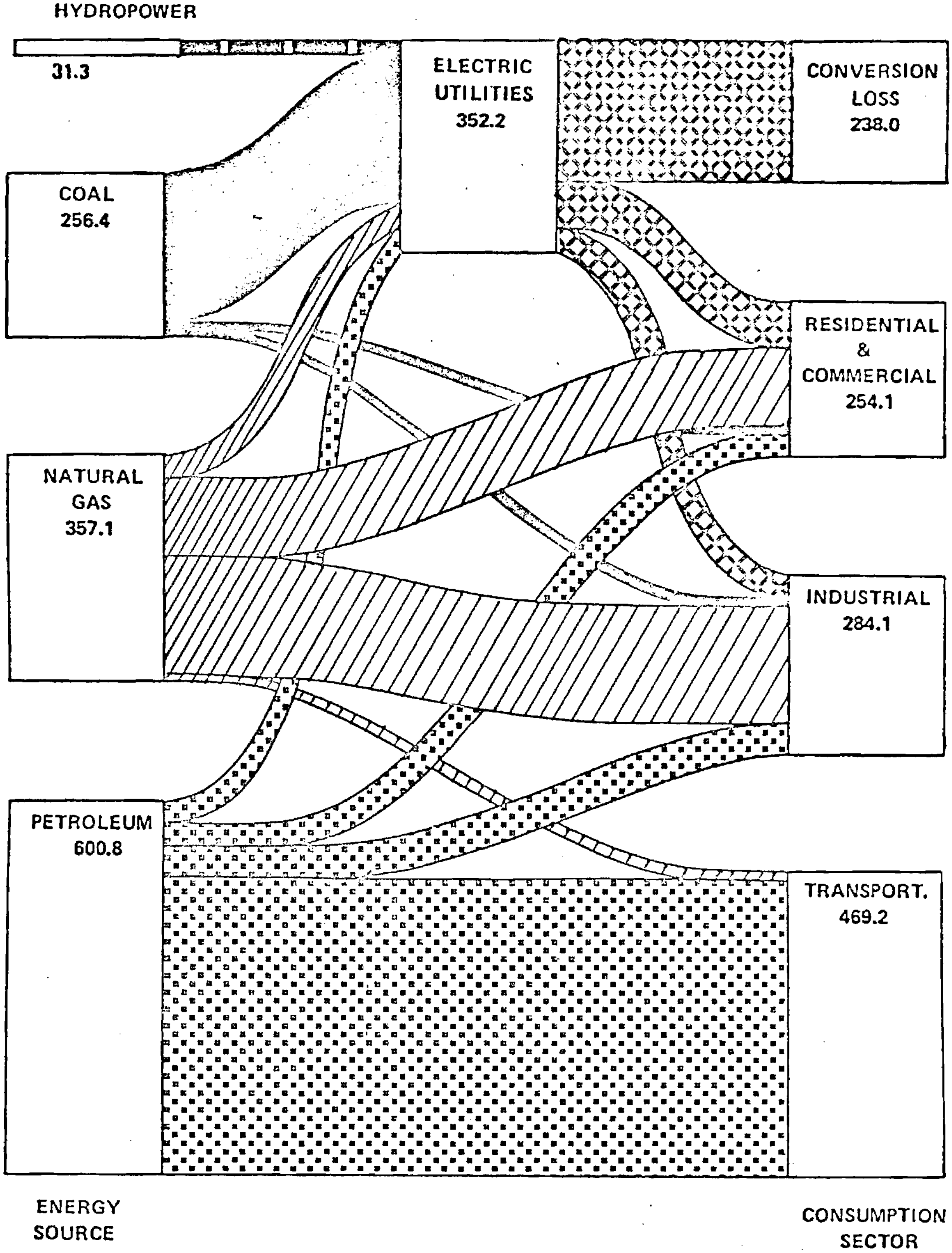
[3]McCallum, Mary, Energy Consumption in Georgia 1973, Atlanta: Georgia State Energy Office, March 1975.

Figure 2



ENERGY FLOW
STATE OF GEORGIA
1973

TRILLIONS OF BTU'S

A comparison of percentage consumption by economic sector in Georgia and the United States is shown in Figure 3. It is evident that the pattern of energy use in Georgia is not similar to that of the United States: for instance, transportation in Georgia consumes 37.6% while only 24.8% in the nation. On the other hand the industrial sector in the nation consumes 28.3% while in Georgia the industrial sector uses only 19.4%. There is a similar difference between the state and the nation in their respective sectors consumption of energy in residential-commerical.

Figure 4 shows a comparison of percentage consumption of fuel resource by Georgia and the United States. There is very little difference between the relative importance and percent consumption of coal, petroleum, natural gas and hydro-nuclear.

FIGURE 3

COMPARISON OF % CONSUMPTION BY ECONOMIC SECTOR IN GEORGIA AND THE UNITED STATES FOR THE YEAR 1973.

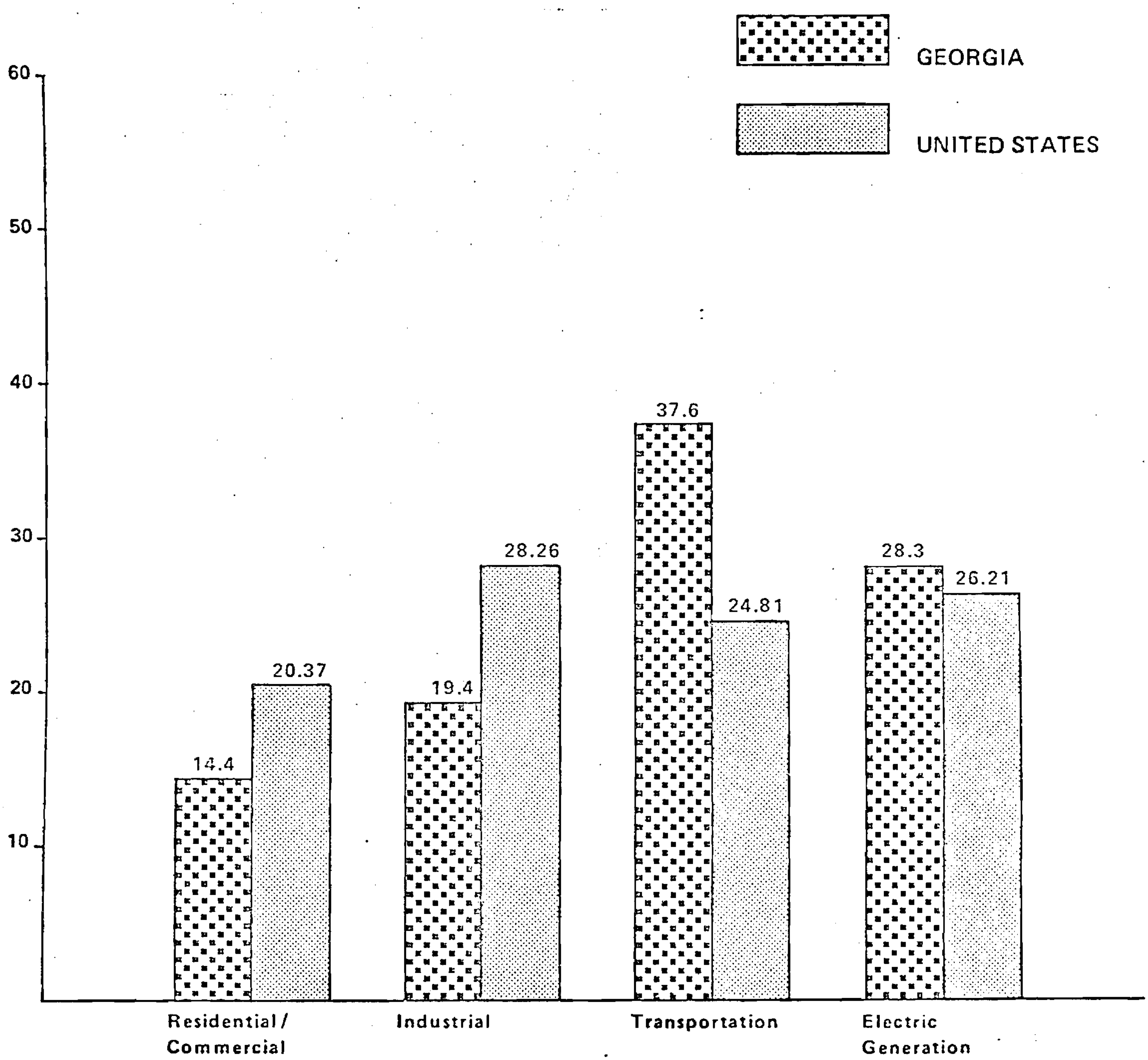
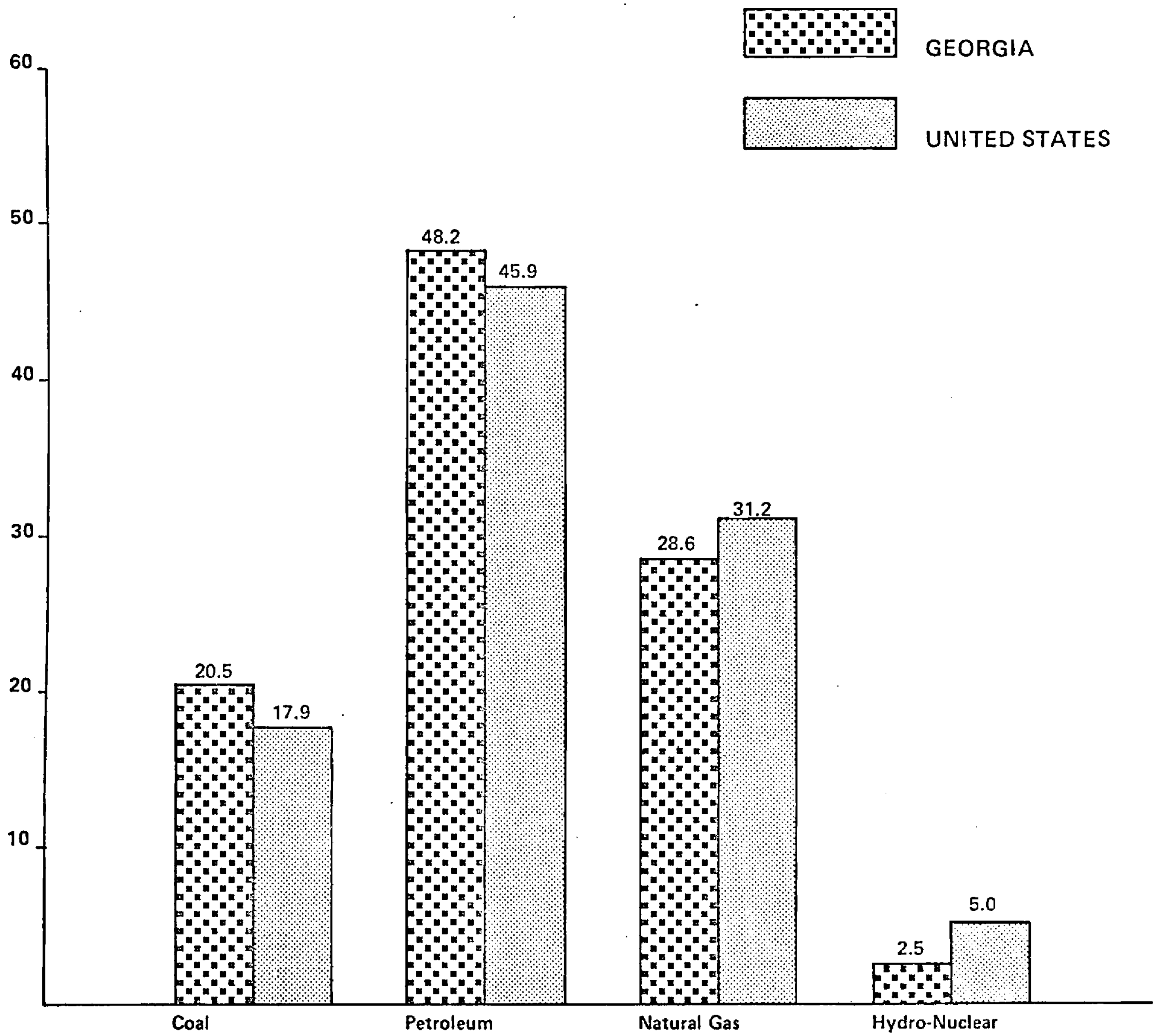


FIGURE 4

COMPARISON OF % CONSUMPTION OF FUEL RESOURCES BY GEORGIA AND THE UNITED STATES FOR THE YEAR 1973.



IV. ENERGY USE WITHIN THE GEORGIA MANUFACTURING SECTOR

So far the nature of energy consumption in the state has been discussed in only general terms. This section, however, deals with the energy consumption patterns of manufacturing firms in 1973 and provides more specific information obtained from the mail survey. The energy consumption of the manufacturing sector was ascertained in two steps: a survey of firms and the expansion of the sample data to cover all firms within the manufacturing sector.

SURVEY OF FIRMS

A survey of firms was conducted to obtain the basic data necessary for the determination of energy consumption patterns of manufacturers in 1973. The sampling procedure and questionnaires used in the mail survey have previously been discussed in the section on methodology.

An analysis of the survey response is shown in Table 6 (all the tables in this section are included at the end of the text). The data on number of firms and employment are those figures reported to the Georgia Department of Labor for the month of July in 1973. According to the sampling plan outlined in the methodology section the number of firms to be surveyed was 2,303. However, as can be seen in Table 1 the actual number of firms surveyed was 2,333. For the most part, the difference can attribute to the inclusion in the sample of thos plants visited during the in-plant audit which were not included in the original sample.

Although approximately 51.9% or 1,211 of the surveyed firms responded, only 733 or 31.4% of the respondents returned usable questionnaires. The usable response, then, represents about 10.1% of the firms in the manufacturing sector and accounted for 24.4% of the sectors' employment. Some of the factors contributing to the high percentage of nonusable responses were as follows: the complexity of the questionnaire; the firm was not in operation in 1973; a firm's energy data had been discarded or stored; incorrect address; utility costs were included in the rent and could not be identified; the reported figures were obviously incorrect and therefore not used; the information supplied was for more than one plant; and some firms had no manufacturing facilities located in Georgia.

For industry groups (SIC 252, SIC 295, SIC 301) the respondents total industry reported employment for 1973 was greater than that shown by the Georgia Department of Labor. Each firm's reported employment and SIC number were checked using the 1973 Georgia Manufacturing Directory to ensure the accuracy of the responses. This procedure indicated that the reported employment figures were correct. One possible explanation is that during the time between the 1973 Labor Department's report and their 1975 mailing list some of the firms changed the types of products they manufactured and hence, their SIC number. For their industry groups, the respondent's reported employment was treated as the total employment in the industry.

ESTIMATION OF ENERGY PARAMETERS

The results of the survey provided the basis for the estimation of energy parameters such as the energy use per employee and the energy used per dollar output. These energy parameters were estimated so that the total energy consumption by industry groups could be calculated. Also, since the parameters relate energy use to industry economic data a means may be provided to evaluate (using the state input-output model) the economic impact in terms of personal income, employment, sales revenue and state/local taxes of various energy situations on the manufacturing sector. Shown in Table 7 are energy mean values which relate plant energy consumption to industry characteristics for the industry groups. Energy use per employee, the expansion factor by which the sample was expanded to obtain an estimate of total energy consumption for an industry, energy use per dollar output, and energy use per firm are all included in Table 7.

The standard deviation and the coefficient of variation, two measures of dispersion, have been calculated for each of the mean values. The standard deviation provides a measure of absolute dispersion while the coefficient of variation provides a measure of the relative dispersion of the means. Although the coefficient of variation is generally expressed as a percentage, it is shown in decimal format (e.g., .84 instead of 84%).

Since in the majority of the three-digit industry categories the number of firms is less than 30 the "Student's" t distribution has to be used to determine the interval estimates. An example of an interval estimate for the Grain Mill Products (SIC 204) with 95% and 80% confidence units is as follows:

$$CI = \bar{X} \pm t_c \frac{S}{\sqrt{N-1}}$$

$\bar{X} = 1311.3$

$S = 1293.0$

$N = 10$

$N - 1 = 9$

where; $\bar{X}$ = mean of the sample

$\pm t_c$ = the confidence coefficients depend on the level of confidence desired and the sample size (from standard tables)

S = standard deviation of the sample

N = sample size

CI = Confidence Interval

- for an interval estimate with 95% confidence limits the estimated total industry energy consumption is between (921,000 - 6,239,000) x 10^7 BTU's

Therefore with 95% confidence limits

$$\pm t_{.975} = 2.26 \text{ and } CI = 1311.3 \pm 2.26\ (1293/\sqrt{9})$$

$$1311.3 \pm 974.1$$

In other words, 95% of the time the energy consumption would be expected to fall within the range of 1311.3 $\pm$ 974.1.

- for an interval estimate with 80% confidence limits the estimated total industry energy consumption is between (1,955,000 - 5,204,000) x 10^7 BTU's

  Therefore with 90% confidence limits

$$\pm t_{.90} = 1.38 \text{ and } CI = 1311.3 \pm 1.38 \ (1293/\sqrt{9})$$
$$1311.3 \pm 595$$

These two interval estimates can be compared with the point estimate of industry energy consumption of 3,602,000 x 10^7 BTU's shown in Table 8. As can be seen from this example the standard deviations of the energy mean values are somewhat disappointing. Even in those instances where the percentage of employment in an industry group covered by the survey was high (e.g., SIC 207, 222, 231, etc), the standard deviations were large for both energy use per employee and energy use per dollar output. Because sales are more closely related to output (hence, energy use) it would be expected that energy use per dollar output would exhibit a smaller standard deviation than energy use per employee. However, an examination of the coefficient of variations for both energy values indicates very little difference.

There are a number of possible explanations for the large standard deviations. If inadequate data and an insufficient sample were to be eliminated as possible causes, then there are two likely explanations. If there were no correlation between energy use and the firm's characteristics as represented by employment and sales, the standard deviations would be large. This explanation seems unlikely, however, especially when one is considering energy use per dollar of output.

Perhaps the primary reason for the large standard deviations is the three-digit industry classification used in the analysis. This industry classification system represents the grouping of industries which manufacture similar products yet the products could have quite different energy requirements. If the industries contained within a three-digit industry category have diverse energy use patterns it would be expected for the data to exhibit a large dispersion about the mean.

The concrete, gypsum, plaster products industry group (SIC 327) which contains several industries, two of which are the Ready-Mix Concrete (SIC 3273) and the Lime (SIC 3274) industries, provides an example of diverse energy use patterns within a three-digit industry category. National data from the Bureau of Census publication 1972 Census of Manufacturers', Fuels and Electric Energy Consumed shows that the quantity of purchased fuels in billions of kilowatt hours equivalent for the concrete industry was 23.5 and for the lime industry was 26.4 while employment respectively was 75,029 and 5,500. As illustrated by these figures, the energy use per employee would have a wide variation within the three-digit industry groups even if all plants in the three-digit categories were identical. Therefore, if the standard industrial classification system is to be used to examine the energy policy issues which face manufacturers the analysis will have to include four-digit and possibly even five-digit industry groups where the energy consumption patterns within a three-digit category are not homogenous.

This discussion on the variation of the means such as energy use per employee implies that the estimated total energy consumption for industry groups must be interpreted with caution and that these estimated figures although discussed as point estimates, should be interpreted as showing relative magnitudes of energy use not exact energy use.

In addition, the findings that energy use per dollar of sales and energy use per employee exhibit large standard deviations have a broader implication. That is, the results from input-output models which utilize such coefficients in the analysis of economic impacts, policy alternatives, etc. are questionable.

PLANT ENERGY CONSUMPTION

The category of plant energy consumption in Table 8 includes all energy consumption except that expended on transportation. Shown for each industry group are the number of respondents, the percentage of total industry employment represented by the respondents, and the respondents' plant energy consumption. For the amount of a specific type fuel consumed by an industry can be determined using the industry's reported plant energy used and the percent usage for the fuel type. The percentages shown on the purchased use of energy do not necessarily represent all firms since a number of respondents did not supply the data. Finally, as mentioned earlier, the total industry plant energy consumption has been estimated using mean values with large variances should therefore be interpreted with caution.

The total industry plant energy consumption figures are of interest because they provide an indication of the relative magnitude of the energy consumption by industry groups. Those industries which used a large percentage of that energy consumed in the manufacturing sector were as follows: Floor Covering Mills (SIC 227) with 9%; Household Furniture (SIC 251) with 7%; Misc. Transportation Equipment (SIC 379), Knitting Mills (SIC 225), and Cut Stone and Stone Products (SIC 328) each with 6%; Textile Finishing, Except Wool (SIC 226) and Misc. Plastics Products (SIC 307) each with 5%; and Sawmills and Planning Mills (SIC 242) and Men's and Boy's Furnishings (SIC 232) each with 4%. These nine industry groups accounted for approximately 52% of the estimated total energy consumed in the manufacturing sector.

The primary fuel used by the manufacturing sector was natural gas which accounted for about 62% of all energy consumed. Natural gas was followed by electricity (25%), fuel oil (7%), LP Gas (5%), and Coal (1%). An examination of the individual industry groups energy consumption patterns provides some indication of the relative importance of fuel sources and consequently identifies those industries which will be effected by energy price changes, shortages, etc.

The manufacturing firms were asked to estimate the plant energy consumption by functional use. The majority of plants do not have instrumentation or keep records; therefore, these figures are based upon the judgement of the respondents. For all manufacturers, space heating and air conditioning (most respondents probably included lighting in this category) accounted for 39% of energy consumed while processing/production accounted for 59% of energy consumed.

TRANSPORTATION ENERGY CONSUMPTION

The number of respondents, the percentage of total industry employment represented by the respondents, and their transportation energy consumption are shown by industry groups in Table 9. Not included in these transportataion energy consumption figures are any transportation services the firms might have purchased. For a specific type of fuel the amount consumed can be determined using the industry's reported transportation energy used and the percent usage for the fuel type. Also shown are the estimated total industry transportation energy consumption.

An examination of the estimated total industry transportation energy consumption indicates that Logging Camps and Logging Contractors (SIC 241) with 29%; Grain Mill Products (SIC 204) with 9%; Meat Products (SIC 201) and Paperboard Containers and Boxes (SIC 265) each with 5%; Bakery Products (SIC 205), Sawmills and Planning Mills (SIC 242), Concrete, Gypsum, and Plaster Products (SIC 327) and Floor Covering Mills (SIC 227) each with 4% were the industry groups which accounted for about 64% of the total transportation energy consumed in the manufacturing sector.

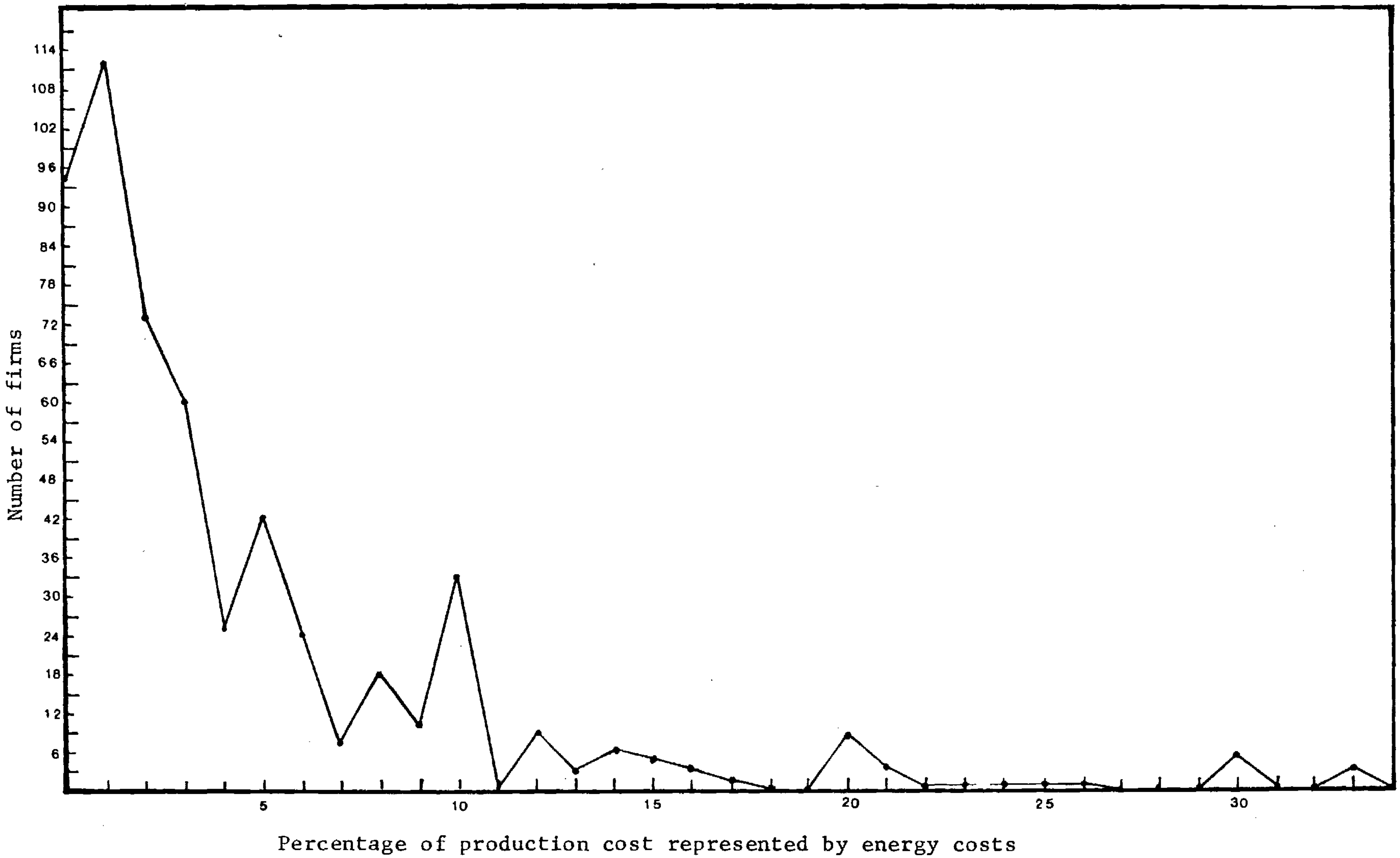
For the manufacturing sector as a whole the percentage breakdown of fuel types was 81% for gasoline and 19% for diesel. The functional use of transportation energy in the manufacturing sector was for on-road use (79%), off-road use (20%), and other (1%). The functional use pattern varied considerably between industries.

ENERGY COSTS

The incentive for a manufacturer to conserve energy will depend to a large extent on the relative magnitude of energy costs in relation to the firm's total production costs. The respondents were asked to estimate the percentage of their total cost of production which was represented by their energy costs. Of the 556 respondents, 16.9% replied that their percentage of energy costs to production costs was between 0.0% to 0.9%; 20.1% that percentage of energy costs to production costs was 1.0% to 1.9%; and 23.9% that percentage of energy costs to production costs was between 2.0% to 3.9%. Altogether 83.6% of the respondents indicated that their percentage cost of energy to production costs was under 10%. Figure 5 presents a frequency diagram which illustrates graphically the relatively small percentage of the total production costs that energy represents.

Figure 5

PERCENTAGE OF TOTAL COST OF PRODUCTION REPRESENTED BY ENERGY, 1973



The energy costs for both plant energy usage and transportation plant usage are shown in Table 10. Estimated total energy costs have not been made because due to the many factors which influence energy costs such as quantity discounts, peak load factors, etc., such figures would not be meaningful.

Table 11 reports the extent of storage capacity for fuel oil and liquid propane gas that was available at plants. The number of respondents who reported facilities is shown as well as the average storage capacity and the storage capacity as a percent of the respondents' annual consumption of the fuel type. A comparison of the number of respondents shown in Table 8 with those respondents which reported storage capacity provides some insight into the proportion of firms with storage facilities. For each industry group the storage capacity as a percent of the annual consumption has been calculated and provides an indication of the extent of the storage facilities for those firms which reported them.

V. IN-PLANT ENERGY AUDIT PROGRAM

GENERAL DISCUSSION

The In-Plant Energy Audit Program had several objectives which included:

- the determination of the potential for energy conservation in the plants visited,
- the energy usage pattern within the plants,
- specific detailed energy and materials consumption data not obtainable from the State Energy Office mail survey,
- technical assistance in the form of specific recommendations for process improvements etc. for each plant visited.

In the case of determining the energy conservation potential, numerous detailed measurements of the temperature, velocity and composition of the various gas and liquid discharges from the plants were required. This frequently involved considerable physical effort on the part of the site visit team members and required the great majority of all the man hours spent during the visits. To illustrate typical site visit activities Figures 6 through 11 are presented. These figures indicate the various types of measurements made and give some indication of the operating conditions normally encountered during a visit.

In conducting the visit program, two teams were utilized and the visits were organized so that the separate teams became specialized in a certain group of industries. This afforded greater efficiency and utilization to the conduct of the program. All told a total of 46 visits were made involving 23 different industries.

One of the major problems faced in conducting the Energy Audit Program was the proper selection of a representative plant within a certain industry. Since the size of the industry sample was only about five percent, this became a critical element in the program planning and later in the data reduction. While every effort was made to select plants having representative sizes and four digit SIC code numbers properly characteristic of a three digit category, there was no way to insure that a truly representative sample was made. This appears to be a serious problem facing any on site program which, because of the costs involved, must necessarily be limited to a relatively small sample of the total population. Thus with this in mind, the results of the study should be strictly interpreted as indicative of "typical" as opposed to representative cases and some recognition of the danger of too broad an interpretation of the results must be recognized.

In the course of the site visit, information concerning the plant energy conservation potential, energy and materials consumption, energy

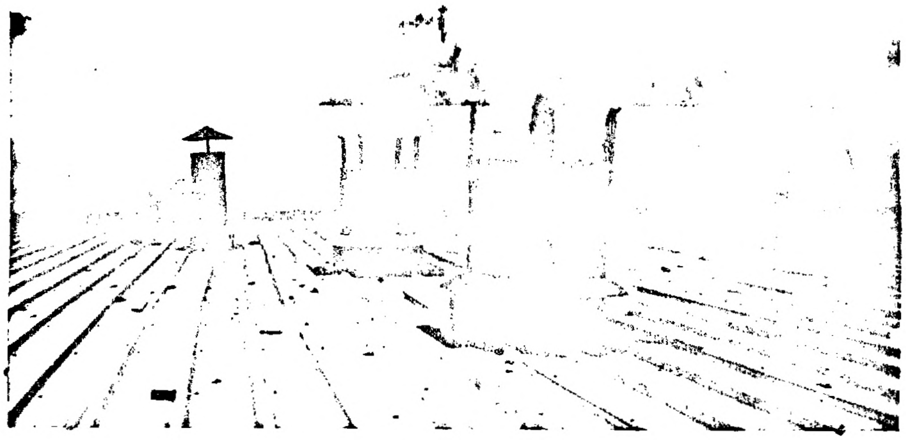


Figure 6. Typical Exhausts from a Carpet Mill

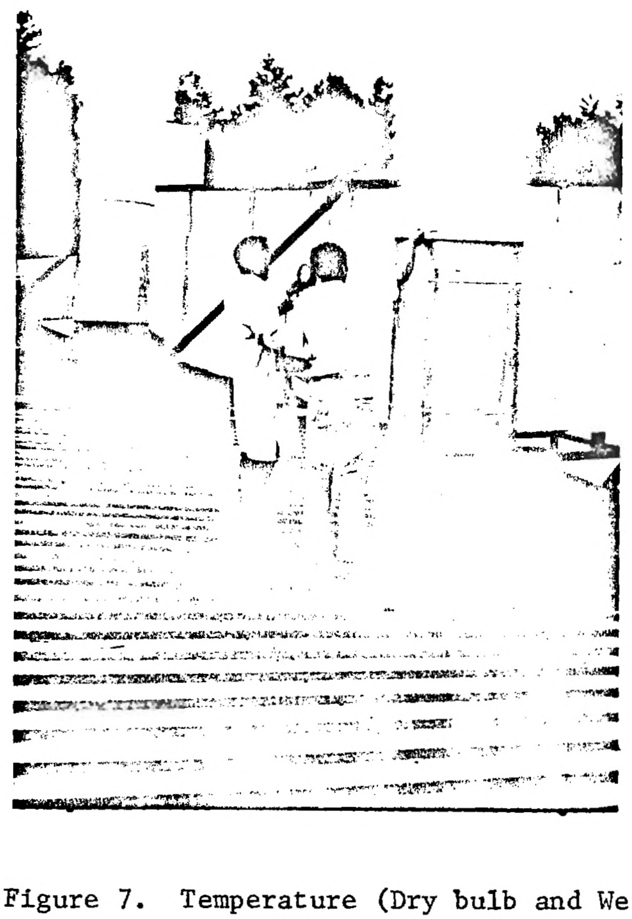


Figure 7. Temperature (Dry bulb and Wet bulb) Measurements From a Drier Exhaust

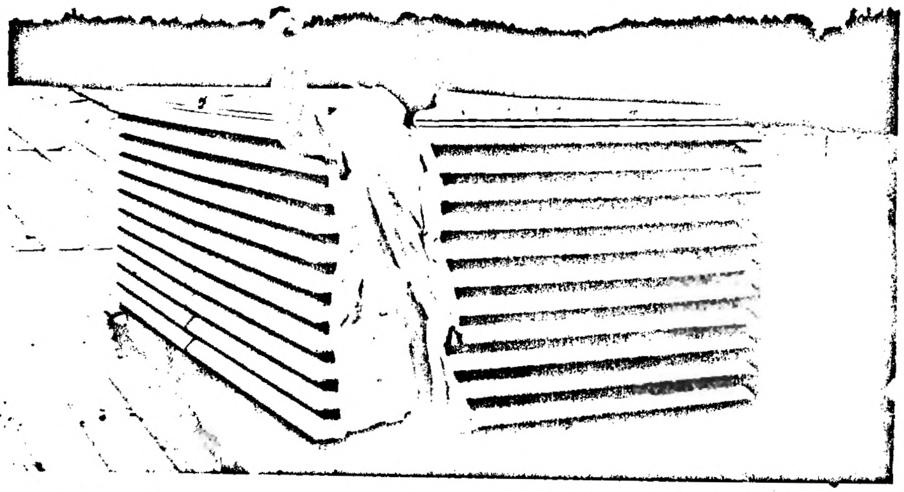


Figure 8. Air Conditioning Exhaust Measurements

Figure 9. Curing Oven Exhaust Velocity Measurements

Figure 10. Orsat Analysis of Boiler Stack Gases

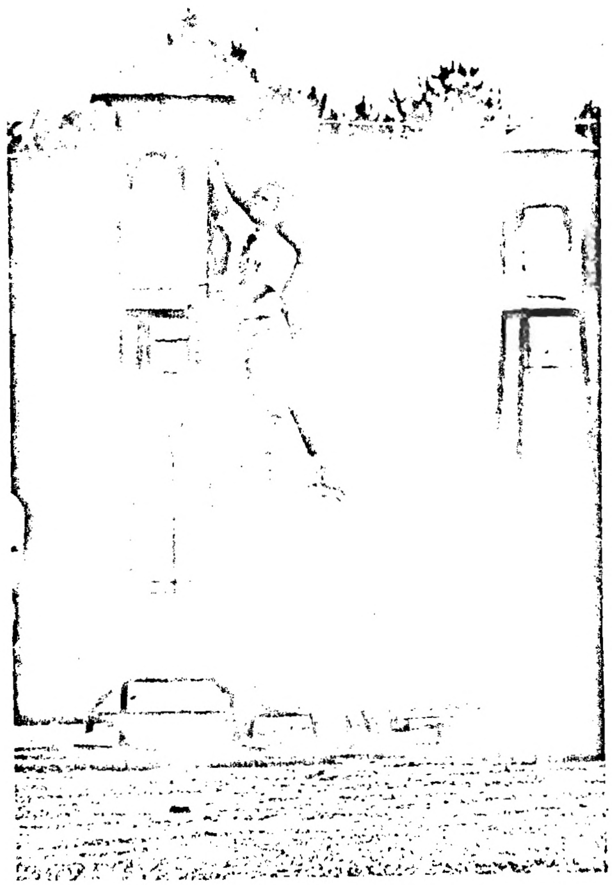


Figure 11. The Hazards of Conducting the Energy Audit

useage, etc., was recorded on a special form, a copy of which is presented in Appendix A. Subsequent to the site visit a report for internal use was prepared summarizing the most salient results of the visit. A copy of a typical report is presented in Appendix C. Depending on the local circumstances, the time available, and the team experience with the particular industry, the quality of the reports varied; thus this particular report is offered only as a sample to illustrate how the collected information was compiled to complete the requirements of the present program. The last step in the analysis of the visit results was the submission of a follow-up letter to the plant supervisor summarizing the findings of the visit team and making specific suggestions as to how improvement (if any) in various processes could be made. A typical follow-up letter is also included in Appendix C.

In the following section the overall results of the Energy Audit Program are shown and the implications of the work, as far as Georgia is concerned, are discussed.

OVERVIEW

The results from the Energy Audit Program have been compiled in the form of tables and for the most convenient usage are presented at the rear of the report. These tables contain a mixture of both quantitative and qualitative results. Since there were often differences within an industry between the various values of the quantitative results for sepatate plants, these data are frequently presented as a range of values. Likewise, where specific values are presented, these should be taken as typical but not necessarily average for a given industry. The necessarily small size of the sample makes it doubtful that any of the numbers presented are really "average". In passing it might be noted that there is some question as to the usefulness and/or meaning of an "average value" since the mail survey indicates that the standard deviation of the results is often several times as large as the mean value itself. Clearly then an "average value" is a ficticious number representative of only a few plants, if any. If it is used for purposes of large scale economic analyses, the sensitivity of the results to variations in the "average" values of different parameters should be studied before any drastic actions or policy initiatives are taken.

A broad overview of the general characteristics, excluding energy conservation potentials, of the industries studied is presented in Table 12. While there are numerous specific points of interest, for example regarding waste production, the most striking result is the typically very small percentage of the value added represented by energy. Except in a few of the smaller energy consuming industries and with the exception of paper, SIC #263, this result appears universal. Thus a very significant fraction (at least 40 percent) of the total state industrial energy consumption is represented by industries in which energy represents only 1 to 5 percent of the total value added. Clearly the economic incentive for conserving energy is therefore very limited in these cases. These industries typically become interested in energy only when it is in short supply and thus threatening their operation. Consequently a major activity has been the installation of large oil storage facilities. This has required capital that otherwise might have gone into maintaining and/or improving existing process efficiency and has likely resulted in a reduction in their overall energy utilization efficiency.

In order to determine the total potential energy savings realizable from energy conservation practices, several computations and/or operations must be made. These include:

- the identification of the important thermal and electrical processes involved and the determination of the fraction of the total energy which each process consumes,
- the identification of techniques for improving the various processes involved,
- the determination of the total energy consumed by each industry.

The following tables, therefore, present information relevant to the goal of determining the potential energy savings and the associated discussion describes how the information was obtained and how it was used. (A brief summary of the methodology used in reducing the data is presented in Section II on Methodology.)

Presented in Table 13 is the percentage of the total energy utilized of separate processes within the various industries studied. Since there can be very significant differences between the individual processes in different plants within a three digit SIC category, (for example a frozen seafood packer and a roasted coffee producer both are in the same three digit category), these numbers, while computed using weighting factors to account for these differences, are again strictly speaking only typical, although every effort has been made to make them representative. Further the numbers shown are based on a combination of indirect measurements, nameplate data, and estimates, since in few if any of the plants visited were any meters available to determine individual process thermal or electrical energy requirements. Thus again caution in too general an interpretation or use of these results is advised.

Tables 14 and 15 present ideas for reducing energy consumption and the estimated energy savings obtained for the major processes encountered in the industries visited. Since HVAC equipment boilers and lighting are common to almost all these industries, to avoid unnecessary repetition, this category has been treated separately and the results are presented in Table 14. Likewise, improvements in the operation of the more esoteric processes for the various industries are presented in Table 15. In both tables, the effects of minor and major changes in equipment are considered. Minor changes are considered to be changes involving improved maintenance, slight modifications to operating procedures, and inexpensive (less than a few hundred dollars) equipment additions. Major changes would involve replacement or substantial modification of existing equipment and would necessarily require substantial financial commitment. In addition to technical improvements, changes in the processes themselves, alternative scheduling and alternate fuels are also considered in Table 15. While the list presented is by no means complete, it does contain typical ideas and estimated energy savings compiled from the Energy Audit Program and should be useful in grasping the types and rough potentials of methods that can be used to improve process efficiency and utilization.

Utilizing the data from Tables 13 through 15 and the industry energy consumption information compiled from the mail survey conducted through the auspices of the State Energy Office, the estimated potential for energy savings can be calculated. Again the results of such an operation must be carefully interpreted since the computations necessarily involve data which because of the various sources from which it is derived and because of the limited scope of the statistical sample from which it is obtained is not as accurate as is desired. However, this situation appears to be inescapable and therefore these results represent the best data that can be produced using the methodology of the current study. With this in mind, Table 16, which lists the estimated energy savings obtainable for the audited Georgia industries, is presented. Also shown is an estimated savings for all these industries together. While there may be some variations between the separate estimates and those from other studies of the potential for energy conservation in specific industries the total estimated savings appears to be in line with various published estimates of industry as a whole. This provides some measure of confidence to the results and to the methodology of the study.

Clearly the results from Table 16 indicate that vast savings of energy in Georgia industry are feasible with even minor improvements in operation procedures. Thus the incentive to realize these economics from energy savings considerations is great. However, until other incentives, such as economic advantages through tax reductions or perhaps increased fuel costs, etc., are present, there unfortunately may likely be little improvement in energy utilization and current wasteful practices will prevail.

VI. THE IN-PLANT ENERGY CONSERVATION AND MANAGEMENT CONFERENCE AND WORKSHOP PROGRAM

BACKGROUND

The statement of work of this project required that the EES prepare and conduct programs and workshops for groups of companies, concerning common energy problems, potential alleviating actions, and methods of increasing the efficiency of energy utilization. Participation of appropriate state and federal personnel in these activities were indicated.

For over 15 years, the Engineering Experiment Station has been directly involved in furnishing management and technical assistance to industrial concerns in Georgia. The experience gained during this period, involving both on-site assistance and training programs, resulted in an approach to the energy conferences and workshops based upon the following considerations.

- Much energy technology now exists; the problem is how to apply it. Accomplishment of other tasks within this project were applied to the development of the conferences and workshops.
- Technology cannot be force fed. The demand for it must be created and nurtured. To apply technology, management must be convinced that technology applications will be profitable.
- Technology must address the current needs of business and industry.
- Technology needs must be communicated to the research and development community through appropriate mechanisms and the research and development community should try to sensitize itself to these needs.

PROGRAM DEVELOPMENT

General Program Characteristics

At the outset it was recognized that no single training program could fully meet the needs of diversified industry in Georgia. However, it was believed that the energy training programs should have the following general characteristics:

- They should be practical and understandable.
- They should be action-oriented with emphasis on immediate action which management can take to make more efficient use of energy, yet give consideration to long-range programs involving considerable capital outlays.

- They should avoid sophisticated approaches beyond the capability of industries in Georgia, yet furnish sound, engineering approaches that are understandable to industrial managers and plant engineers.

- Teaching methodologies and materials should be sufficient to insure good program continuity but flexible enough to meet local and regional industrial need throughout the state.

It was determined that the ultimate objectives of any in-plant energy conservation and management program should be an inherent factor in the training to be conducted. These overall program objectives are as follow:

- Increase profits by savings on energy costs

- Prevent business or plant shutdowns due to energy shortages

- Keep people working

- Keep U. S. industry competitive

- Keep U. S. industry as free from government controls as possible.

Approach to Program Structuring

In view of the general program characteristics desired, it was determined that two types of training sessions should be conducted. Previous experience in the conduct of training programs and in furnishing management and technical assistance to business and industry in Georgia confirmed the belief that management will not attend training sessions or permit employees to attend unless there is some assurance that such training will improve the companies' profit position, not that training will improve the employees' performance. Accordingly, it was determined that two types of programs were needed.

The first program developed was designed along the conference concept. The essential attribute of the conference is that it permits adequate group discussion and interchange of information among participants. Thus, the In-Plant Energy Conservation and Management Conference which was conducted in eight locations in Georgia was designed to create an awareness on the part of industrial managers of the profit advantages of undertaking a program within their plant that would result in the more efficient use of energy.

The second program developed was specifically designed to assist technical personnel and personnel involved in assisting management of industrial concerns to analyze their situation with respect to energy costs and availability, as well as furnishing assistance and guidance in establishing in-plant conservation and management programs.

Constraints placed on the amount of time management was willing to devote in attending training sessions was reflected in the designing of the training programs. It was determined that at most, management itself was willing to spend not over three hours at an initial session. In view of the essential content required of the workshop, it was determined that a one-day session was necessary.

PURPOSE AND SCOPE OF PROGRAMS

In-Plant Energy Conservation and Management Conference

This conference was designed to assist management of industrial concerns analyze their situation with respect to energy costs and availability, and to furnish assistance and guidance in establishing in-plant energy conservation and management programs when desired. The program agenda was as follows:

- Welcome by a local official
- Program introduction
- Energy: The Critical Choices Ahead - An 18 minute film developed by the U. S. Department of Commerce depicting the critical need for energy conservation in business and industry in the months ahead.
- Summary of current governmental policies and programs that affect industrial use of energy and assistance furnished by the State Energy Office
- Engineering approaches to energy conservation
- Developing and installing the In-Plant Energy Conservation Program
- Where do we go from here? A question and answer interchange session.

Technical Workshop

The technical workshop was designed to assist industrial firms in establishing programs to meet the rising costs of energy and energy shortages. More specifically, the objective of the workshop was to assist technical personnel and personnel involved in assisting management of industrial concerns to analyze their situation with respect to energy costs and availability, as well as furnishing assistance and guidance in establishing in-plant energy conservation and management programs where desired. Instruction was given in the following topics:

- How to conduct an energy survey - What to look for - How to measure
- How to assist management in installing and conducting the in-plant energy conservation and management programs
- How to identify, analyze, and recommend courses of action for specific energy problems - boilers, electrical machinery, lighting, heating, ventilation, and air conditioning.

Program Documentation

Two types of program documentation was devised. First documentation was needed so that the experience gained in performing the conferences and workshops could be utilized by others. A program scenario of the In-Plant Energy Conservation and Management Conference is attached to this report as Appendix D. The training package for conducting the technical workshop is also included in Appendix D.

A second type of documentation devised was designed for program participants. This documentation consisted of supplementary materials in the form of handouts, copies of visual aids used, and publications furnished by cooperating agencies such as the power companies.

PROGRAM PROMOTION

Involvement of Local Organizations

Although there are certain patterns of industrial location in Georgia such as the carpet industry in north Georgia and the mobile home industry in the south, by and large, industry is quite diversified throughout the state. Basically, Georgia is a nonmetropolitan state, although much of the industry in the state is located in or near centers of population. Not only is industry quite diversified through the state, but industrial managers are usually not readily accessible to attend frequent seminars and/or other types of meetings.

Since the training programs were to be conducted throughout the state, it was considered advisable to seek the cooperation of local organization in hosting the several training sessions. It appeared that the most logical organizations to lend assistance were the area planning and development commissions (APDC's). Since these organizations had been closely involved with activities of the Economic Development Administration (EDA), and many in fact were economic development districts funded in part by EDA, it was only logical to seek their assistance. Also, the APDC's were in a position to enlist the support of chambers of commerce in their area and field offices of the Engineering Experiment Station have a history of cooperation with the commissions.

The following APDC's participated in the conduct of the training programs:

- Northeast Georgia Area Planning and Development Commission
- Middle Georgia Area Planning and Development Commission
- North Georgia Area Planning and Development Commission
- Southwest Georgia Area Planning and Development Commission
- Coastal Area Planning and Development Commission.

Each APDC assisted in the execution of the program as follows:

- Prepared and disseminated promotional materials within their area
- Arranged for suitable locations for the conduct of training sessions
- Cooperated with other local organization in furthering the program
- Formal introduction of the training team to local participants

Formal Announcements

The primary purpose of program promotion was to inform industrial managers in the several target areas of the In-Plant Energy Conservation and Management Conference and the Technical Workshop. The formal promotion program is a series of brochures and news releases related to each program to be conducted at each location. Using a sample brochure prepared by the Engineering Experiment Station, each APDC prepared and printed a brochure for the sessions conducted in their commission area. The cost of printing and mailing of the brochures was defrayed by project funds.

News releases were issued by both the Engineering Experiment Station and the APDC's.

Informal Promotion

It appears that some of the most effective promotion was achieved through the efforts of EES field office personnel who were able to communicate with managers of concerns to whom the field offices had furnished management and technical assistance in the past under programs funded by the Economic Development Administration. In addition, personnel of the Commission's staff were of great assistance.

Media Response

In most situations the media responded favorable in announcing the program and in covering and reporting the sessions. Media coverage included television, as well as the newspapers.

CONDUCT OF TRAINING

Seventeen training sessions were conducted as follows:

IN-PLANT ENERGY CONSERVATION AND MANAGEMENT CONFERENCE

Location	Date
Athens	March 6, 1975
Columbus	March 13, 1975
Albany	March 18, 1975
Macon	March 19, 1975

Brunswick	April 2, 1975
Savannah	April 3, 1975
Dalton	April 10, 1975
Gainesville	May 15, 1975
Atlanta	May 21, 1975

Technical Workshop

Macon	April 15, 1975
Albany	April 16, 1975
Columbus	April 22, 1975
Athens	April 24, 1975
Brunswick	April 29, 1975
Savannah	April 30, 1975
Dalton	May 14, 1975
Gainesville	May 29, 1975

Participants

A total of 230 participants attended the several training sessions.

VII. TECHNICAL ASSISTANCE

The technical assistance to Georgia industry provided through the overall program was primarily focused in the site visits and in the conferences, workshops, although a few special cases developed in which plants received direct help independently of these two mechanisms. The reaction of the various industries participating in the overall program has been quite positive and many requests for assistance (which unfortunately currently remain unanswered) have originated. Thus the need for an additional program including a continuing technical assistance phase is strongly indicated.

In the on site energy audit program, the team members met with the plant supervisor at the end of the day and provided him with a preliminary verbal assessment of the plant operations. This was followed by a letter summarizing the findings so far as potential improvements were concerned. A sample follow-up letter is presented in Appendix C. Because so much of the assistance was in a verbal form and because it is not practical to include all the follow-up letters in this report, it is difficult to quantify the amount of assistance that was provided. However, to give some idea of the scope of this assistance the following partial list is included:

SIC Number		Typical Suggestion
222	-	Recommendations for significant improvement in polypropylene extrusion system were made.
262	-	Recommendations for increases in dryer efficiency through use of baffles to improve internal air distribution were made.
295	-	Recommendations for replacing trucks with large mechanical conveyers were offered.
327	-	A better design of plaster mold heaters was developed.
329	-	Significant improvements in operation of a calciner kiln were suggested.
335	-	Improvements in smelting furnace operation were suggested.
363	-	Major changes in enameling ovens were suggested.
371	-	The use of circulatory fans to reduce air stratification and cut HVAC costs were suggested.

In the Conference/Workshop series where almost all the technical assistance was of a verbal nature, there is also no way to describe quantitatively the type and scope of assistance provided. However, one measure of the value of these programs was the overwhelmingly positive response to the evaluation form used to critique each of the sessions. The frequent questions asked, the informal manner of these meetings and the fact that in almost every case the meetings lasted for longer than scheduled because of the audience response bore testimony to the value of this type program to Georgia industry.

Thus there is no doubt that this latter program should be continued. When it is recognized that the very positive response it received occurred in a climate of economic recession and with relative fuel abundance for Georgia industry, it is apparent that threre would doubtless be much greater response in times of economic recovery with likely resulting fuel shortages.

VIII. ENERGY POLICY QUESTIONS

A number of management and policy questions arose during the series of conferences held throughout the state. The following are some of the questions or problems industry people attending the statewide conference asked:

- Will those firms that now voluntarily achieve significant conservation be exposed inadvertently to "penalty" later by mandatory programs and allocations that set baselines that are relatively higher for "unconserving" competitors?

- Can mandatory conservation and allocation programs be structured to permit successful conservers to channel some of the energy savings into allowances for growth or expansion?

- How can businesses in one state be assured of equal treatment with their competitors in other states, if each state devises its own rules for energy allocation or conservation?

- Can energy conservation and allocation programs be set up without further injection of government bureaucracy as another item in the list of governmental burdens?

- What kind of incentives can be provided for making investments and incurring risks to conserve energy beyond those normally involved in business economics, recognizing that energy conservation competes economically with other business alternatives for the use of capital?

- What kind of mechanisms can be developed at the sub-state level to get effective industrial community scheduling of operations to reduce costly peak demands for energy, particularly electrical energy?

- Is there anything that can be done if there is any validity to observations by businesses that there is a penalty as a result of conservation that reduces electrical consumption, thereby causing the electrical utilities of offset lost income by rate increases?

- Can technical instrumentation be made available in some reasonable way, particularly to smaller business, so that each will not have to invest in instruments in order to implement strong and effective conservation programs for those types of operations where more detailed energy accounting is needed?

IX. ENVIRONMENTAL CONSIDERATIONS

Since this work has as its general objective the collection of and dissemination of technical data regarding industrial energy utilization in Georgia, there is no direct environmental impact of the program itself. However since some of the results of the program involve ways to conserve energy and thus reduce exhaust emissions, and also ways to use waste materials as an alternate energy source, there is an indirect environmental impact of the work; happily quite favorable. Clearly the use of reduced amounts of energy would results in less direct environmental contamination and in a larger sense would reduce the risks and hazards associated with the production and transportation of the fuels required. Likewise the use of wastes as an alternative energy source has a similar effect at a larger scale and locally relieves pressure on already strained facilities for waste disposal. Thus those considerations relevant to the environment appear to be all very positive.

Since all the technical assistance has been made within the framework of compliance with existing and planned environmental standards, there appear to be no results of the study which will produce any adverse environmental effects. Likewise there should be no negative long time effects on productivity resulting from this work as it relates to short term uses of the environment. And finally no adverse final commitments of natural resources would be involved should the suggested energy conservation methods be implemented.

X. CONCLUSIONS

From the results of this program several important conclusions can be drawn. They are:

1. Since energy costs frequently represent a small fraction of the total production costs, there is little incentive in saving energy, especially since capital expenditures are often required to realize energy saving. There is however a substantial potential for energy conservation within Georgia industry, even with minor modifications to existing practices.

2. Except for very large plants, there is almost a total absence of any internal energy accounting. Thus the effectiveness of energy conservation methods cannot be measured except for an entire plant, a condition not conducive to intensive development of individual process efficiency. Clearly individual metering of large plant components is vitally needed.

3. Significant difficulties in the data gathering, in the interpretation of the data and in the expansion of the data from the sample to the total industrial population are present in studies such as this. Therefore, caution must be taken in too broad and careless use of the results of this program.

4. There are significant policy questions which have arisen suggesting the difficulties that will be encountered in the establishment of industrial energy controls.

5. There is a continuing need for technical assistance to industry in the area of energy conservation practices. Typically small to medium size plants will require considerable guidance in establishing and maintaining these programs.

6. The success of the site visit program suggests that further indepth case studies would provide a useful mechanism for demonstrating the economic value of the ideas developed during this program.

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APPENDIX A

SAMPLE

ENERGY CONSUMPTION AUDIT FORM USED IN IN-PLANT ENERGY AUDIT PROGRAM

GEORGIA ENERGY CONSUMPTION AUDIT

PROPRIETARY

Company Name ______________________________ Date __________

Plant Location ______________________________ County __________ SIC # __________

(1) Please provide the following information on the products your plant manufactures or processes:

	Primary Products	1973 Production	Unit (lbs., parts, yds., etc.)
a.			
b.			
c.			
d.			
e.			

(2) What was your 1973 sales in dollars? __________ dollars

(3) What was your 1973 employment? Number of employees __________.

(4) What was your normal production schedule in 1973: Days per year __________.
Shifts per day __________. Hours per shift __________.

(5) Circle "P" for Primary and "S" for Secondary for those fuels you used in 1973.

a. P S Electricity
b. P S Natural Gas
c. P S LPG
d. P S Fuel Oil
e. P S Coal
f. P S Other, please specify ______________________

(6) Please estimate the percent of total of each type of fuel used (excluding transportation) in 1973 for: (if percent is not known, please indicate (check) what fuel was used for)

	Electricity	Natural Gas	LPG	Fuel Oil	Coal	Other
a. Space Heating and Air conditioning	____%	____%	____%	____%	____%	____%
b. Processing/production	____%	____%	____%	____%	____%	____%
c. Fuels used but not counted in a and b above	____%	____%	____%	____%	____%	____%
	100%	100%	100%	100%	100%	100%

(7) Transportation Energy Consumption in 1973.

(a) Please estimate the percent of each type of fuel used in 1973 for:

	Gasoline	Diesel	Other
1. On-road use	____%	____%	____%
2. Off-road use (i.e. forklifts)	____%	____%	____%
3. Fuels used but not counted in 1 and 2 above	____%	____%	____%
	100%	100%	100%

(b) Please provide the following information on your transportation fuel use in 1973.

	Quantity (Gallons)	Cost (Dollars)
Gasoline	______	______
Diesel	______	______
Other	______	______

(8). Electricity Consumption in 1973:

a. Please provide the following information from your monthly electrical bills for 1973.

	Quantity (KWH/Mo)	Cost (Dollars/Mo)
JAN.	______	______
FEB.*	______	______
MAR.	______	______
APR.	______	______
MAY	______	______
JUNE	______	______
JULY	______	______
AUG.*	______	______
SEPT.	______	______
OCT.	______	______
NOV.	______	______
DEC.	______	______
Total	______	______

*Please provide the following information from your February and August electrical bills for 1973.

	February	August
KWR or RKVA	______	______
Peak Demand	______	______
Connected KW/Mo	______	______

b. If monthly electricity bill information was not available what was the electricity bill in 1973 ______ dollars/year?

c. Did you generate electricity for plant operations in 1973?

______ No

______ Yes, if so, what was the ______ KWH/yr of electricity generated in 1973?

d. For what general purposes was electricity used in your plant in 1973?

1. Processing/Production ______ Yes ______ No
2. Space Heating ______ Yes ______ No
3. Space Air Conditioning ______ Yes ______ No
4. Other, Please specify ______

PROPRIETARY

(9). Did you use Natural Gas in 1973? _________ Yes _________ No

a. Please indicate which of the following fuel types you received through the Natural Gas pipeline.

_______________ Natural Gas

_______________ Manufactured Gas

_______________ Propane/Air

b. The billing procedures used by different gas companies vary, please indicate the quantity measurement shown on your bill.

__________ therms

__________ c.f. at __________ BTU/c.f.*

__________ c.c.f. at __________ BTU/c.f.*

__________ m.c.f. at __________ BTU/c.f.*

*If BTU/c.f. is not shown on the bill, please list your gas supplier.

____

c. Please provide the following information from your monthly natural gas bills for 1973.

	Quantity/Mo	Dollars/Mo
JAN.		
FEB.		
MAR.		
APR.		
MAY		
JUNE		
JULY		
AUG.		
SEPT.		
OCT.		
NOV.		
DEC.		
Total		

d. If monthly natural gas bill information is not available what was the natural gas bill in 1973? ____________________ dollars/yr.

e. If natural gas was used for processing and there was a 20% reduction in your gas supply, please estimate the percent reduction in your production.

(1) If alternate fuel is available ______%.

(2) If no alternate fuel is available ______%.

f. If your plant is on interruptable gas, what is the alternate fuel (i.e. # 2 fuel oil, LPG, etc.)

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

g. Please indicate your natural gas consumption pattern in 1973.

__________ All Months

__________ Seasonal use. Please circle specific months:

J F M A M J J A S O N D

__________ As Needed.

__________ Other, please specify ____

(10) Did you use LPG (propane) in 1973? _____ Yes _____ No

a. Please provide the following information on your LPG use in 1973.

Quantity ____________ Gallons/year

Cost ______________ Dollars/year

b. If annual LPG information is not available, please provide the following information from your LPG bills for 1973.

Delivery	Quantity (Gallons)	Cost (Dollars)
1		
2		
3		
4		
5		
6		
Total		

*If order quantity is by tank, please specify tank capacity. ______ gallons.

c. If LPG was used for processing and there was a 20% reduction in your LPG supply, please estimate the percent reduction in your production.

(1) If alternate fuel is available _______%.

(2) If no alternate fuel is available ________%.

d. Please indicate your LPG consumption pattern in 1973.

__________ All Months

__________ Seasonal Use. Please circle specific months:

J F M A M J J A S O N D

__________ As needed as a back up fuel

__________ Other, please specify ______________________________

e. If LPG is used for a back-up or secondary fuel source, what is the primary fuel? ______________________________

Can any other fuel besides LPG be used as a back-up fuel? ______ Yes ______ No
If no, why not? ______________________________

Please comment on the efficiency of energy use in your production process using the back-up fuel (LPG) rather than the primary fuel.

f. Please indicate the amount of storage capacity available for LPG

__________________ gallons.

PROPRIETARY

(11) Did you use Fuel Oil in 1973? ________Yes ________No

a. Please indicate the grades of fuel oil used.

_____ #1 Kerosene

_____ #2 Fuel Oil

_____ #4 Intermediate Grades

_____ #5, #6, Bunker C Fuel Oil

b. Please provide the following information for each fuel grade used in 1973.

Fuel Grade	Delivery	Quantity (Gallons)*	Cost (Dollars)
# _____	1		
	2		
	3		
	4		
	5		
	6		
	Total		

Fuel Grade	Delivery	Quantity (Gallons)*	Cost (Dollars)
# _____	1		
	2		
	3		
	4		
	5		
	6		
	Total		

Fuel Grade	Delivery	Quantity (Gallons)*	Cost (Dollars)
# _____	1		
	2		
	3		
	4		
	5		
	6		
	Total		

* A barrel contains 42 gallons.
* A drum contains 55 gallons.

c. If individual fuel oil bill information was not available what was the the total fuel oil bill for 1973.

Cost ______________Dollars/yr.

Quantity_______________Gallons/yr.

d. If fuel oil was used for processing and there was a 20% reduction in your fuel oil supply, please estimate the percent reduction in your production.

(1) If alternate fuel is available______%.

(2) If no alternate fuel is available_______%.

e. Please indicate your fuel oil consumption patterns in 1973.

o Fuel Grade #________

___________All Months

___________Seasonal use. Please circle specific months.

J F M A M J J A S O N D

___________As needed as a back-up fuel

___________Other, please specify___________________________________

o Fuel Grade #________

____________All Months

____________Seasonal use, please circle specific months

J F M A M J J A S O N D

____________As needed as a back-up fuel

____________Other, please specify__________________________________

f. If fuel oil is used for a back-up or secondary fuel source, what is the primary fuel?_____________________________

Please comment on the efficiency of energy use in your production process using the back-up fuel (fuel oil) rather than the primary fuel.

____

____

____

g. Please indicate the amount of storage capacity available for fuel oil.

Fuel Grade	Storage
#________	________ gallons
#________	________ gallons
#________	________ gallons

(12) Did you use coal in 1973? ________Yes ________No PROPRIETARY

a. Please indicate the type of coal you used in 1973.

________steam coal (nut and slack)

________stoker coal

________other, please specify________

b. Please list your local supplier.________

c. Please provide the following information on your Coal use in 1973.

Cost ________Dollars/yr.

Quantity________Tons/yr.

d. If annual coal information is not available, please provide the following information from your coal bills for 1973.

Delivery	Quantity (Tons/yr.)*	Cost (Dollars/yr)
1	________	________
2	________	________
3	________	________
4	________	________
5	________	________
6	________	________
Total	________	________

*Quantity could be given in carloads, but ask for tons since carloads vary.

e. If coal was used for processing and there was a 20% reduction in your coal supply, please estimate the percent reduction in your production.

(1) If alternate fuel is available________%.

(2) If no alternate fuel is available________%.

f. Please indicate your coal consumption patterns in 1973.

________All months.

________Seasonal use. Please circle specific months.

J F M A M J J A S O N D

________As needed as a back-up fuel.

________Other, please specify________

g. If coal is used for a back-up fuel or secondary fuel source, what is the primary fuel?________

Please comment on the efficiency of energy use in your production process using the back-up fuel (coal) rather than the primary fuel.

____

____

____

h. What average inventory of coal do you maintain?________

____

(13) Did you use any fuel not covered in previous questions? _____Yes _____No

a. Describe fuel____

____

b. What was the total quantity and cost of fuel in 1973.

Quantity____________

Cost________________

c. If fuel was used for processing and there was a 20% reduction in your fuel supply, please estimate the percent reduction in your production.

(1) If alternate fuel is available_______%.

(2) If no alternate fuel is availabe_______%.

d. Please indicate your fuel consumption patterns in 1973.

_________All months.

_________Seasonal use. Please circle specific months.

J F M A M J J A S O N D

_________As needed as a back-up fuel.

_________Other, please specify_______________________________________

PROPRIETARY

(14) Economic Analysis of Energy Costs

a. List below the total energy cost using the data provided in the previous questions. If the data is incomplete, please estimate total energy cost.

For those fuels with storage capacity please estimate the % change in the inventory level between January 1973 and December 1973.

	1973 Cost of Energy	% Change Inventory Level	1973 Energy Consumption
Electricity	$______	______	______
Natural Gas	______	______	______
LPG	______	______	______
Fuel Oil	______	______	______
Coal	______	______	______
Other	______	______	______
Total	______	______	______

b. Please estimate the percent of your cost of raw materials in 1973 represented by your energy costs. ______%

c. Please estimate the percent of your total cost of production represented by your energy costs. ______%

d. In general, what has been the effect of the increase in energy cost on product price. ________________________

e. In general, has the increase in energy cost had any effect on your ability to maintain and serve your existing markets.

Processing ________________________

Transportation ________________________

(14) Raw Materials and Waste Analysis

a. Has your production been effected by the loss, cut-back or price rise in energy-related or other types of raw materials? ______No

______Yes, please list the raw materials and the nature of the problems.

Material	Problem
1.________________	________________
	________________
	________________
	________________
2.________________	________________
	________________
	________________
	________________
3.________________	________________
	________________
	________________
	________________
4.________________	________________
	________________
	________________
	________________

b. What waste materials are produced and in what amounts?

Waste	Quantity Units/Time Period
________________	________per________
________________	________per________
________________	________per________
________________	________per________

c. Are these wastes separate or are they mixed together and could they be easily separated?

Waste	Comments
________________	________________
	________________
	________________
________________	________________
	________________

Waste	Comments
__________	__________
	__________
	__________
__________	__________
	__________
	__________
__________	__________
	__________
	__________

Persons contacted:

Name:____________________ Title:____________________

Phone:____________________

Name:____________________ Title:____________________

Phone:____________________

Name:____________________ Title:____________________

Phone:____________________

Survey made by:____________________ Date:____________________

PRO[illegible]Y

GEORGIA ENERGY FLOW AUDIT

COMPANY NAME ____

(1) Sketch a flow diagram of the process indicating where raw materials (including energy) enter and where products and wastes leave. (Do not forget to include the power plant and heating system.)

(2) (a) Identify on the sketch the parts of the process that are the major energy consumers and estimate the amount of fuel used.

(b) What specific pieces of equipment consume large amounts of energy?

Equipment	Make and Model	Fuel Used	Amount (Unit/Time Period)
________	________	________	______per_____
________	________	________	______per_____
________	________	________	______per_____
________	________	________	______per_____
________	________	________	______per_____

(3) Remarks (include comments on efficiency of energy use, the use of infrared heaters, etc., special ventilation requirements or safety standards that affect energy consumption, and light levels):

(4) Please list any energy conservation ideas obtained from employees and describe the company's energy conservation program if one exists.

GEORGIA ENERGY CONSUMPTION AUDIT

Company Name ______________________________ Date __________

Plant Location ______________________________ County __________ SIC # __________

(7). Electricity Consumption in 1973:

a. Please provide the following information from your monthly electrical bills for 1973.

	Quantity (KWH/Mo)	Cost (Dollars/Mo)
JAN.		
FEB.*		
MAR.		
APR.		
MAY		
JUNE		
JULY		
AUG.*		
SEPT.		
OCT.		
NOV.		
DEC.		
Total		

*Please provide the following information from your February and August electrical bills for 1973.

	February	August
KWR or RKVA		
Peak Demand		
Connected KW/Mo		

PROPRIETARY

(8). Did you use Natural Gas in 1973? ________ Yes ________ No

b. The billing procedures used by different gas companies vary, please indicate the quantity measurement shown on your bill.

________ therms

________ c.f. at ________ BTU/c.f.*

________ c.c.f. at ________ BTU/c.f.*

________ m.c.f. at ________ BTU/c.f.*

*If BTU/c.f. is not shown on the bill, please list your gas supplier.

____

c. Please provide the following information from your monthly natural gas bills for 1973.

	Quantity/Mo	Dollars/Mo
JAN.		
FEB.		
MAR.		
APR.		
MAY		
JUNE		
JULY		
AUG.		
SEPT.		
OCT.		
NOV.		
DEC.		
Total		

PROPRIETARY

(9) Did you use LPG (propane) in 1973? _____ Yes _____ No

a. Please provide the following information on your LPG use in 1973.

Quantity ____________ Gallons/year

Cost ______________ Dollars/year

b. If annual LPG information is not available, please provide the following information from your LPG bills for 1973.

Delivery	Quantity (Gallons/yr.)*	Cost (Dollars/yr.)
1		
2		
3		
4		
5		
6		
Total		

*If order quantity is by tank, please specify tank capacity. _____ gallons.

(10) Did you use Fuel Oil in 1973? _________ Yes _________ No

b. Please provide the following information for each fuel grade used in 1973.

Fuel Grade	Delivery	Quantity (Gals./yr.)*	Cost (Dollars/yr.)
# _______	1		
	2		
	3		
	4		
	5		
	6		
	Total		

Fuel Grade	Delivery	Quantity (Gals./yr.)*	Cost (Dollars/yr.)*
# _______	1		
	2		
	3		
	4		
	5		
	6		
	Total		

* A barrel contains 42 gallons.

11. Did you use coal in 1973? _______Yes _______No

d. If annual coal information is not available, please provide the following information from your coal bills for 1973.

Delivery	Quantity (Tons/yr.)*	Cost (Dollars/yr.)
1		
2		
3		
4		
5		
6		
Total		

* Quantity could be given in carloads, but ask for tons since carloads vary.

Please return to the IDD field office representative or mail to the following address:

David S. Clifton,Jr.
Industrial Development Division
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

APPENDIX B

SAMPLE

MAIL SURVEY ENERGY CONSUMPTION AUDIT FORM CONDUCTED BY THE STATE ENERGY OFFICE

STATE ENERGY OFFICE

7 Hunter Street, Rm. 145
Atlanta, Georgia 30334
(404) 656-5176

LEWIS C. SPRUILL
Director

February 5, 1975

Dear Sir:

The State Energy Office was established to administer the allocation of the state's reserves of petroleum products and to advise the Governor and other state officials on energy matters. Information on energy use is needed in order to develop energy policy alternatives and to assure fair fuel allocation procedures.

The enclosed questionnaire has been developed to obtain the necessary energy consumption and economic data from the industrial sector. The questionnaire is being sent to a number of the industrial firms in the state. Your answers to the questionnaire will be grouped with similar firms to insure that individual company returns will be kept confidential.

Please complete the parts of the questionnaire which apply to you and return it in the enclosed envelope. If you have any questions concerning current energy problems, please send a letter explaining your situation or give us a call, (404)656-5176.

Your cooperation and prompt attention in this matter will be greatly appreciated.

Sincerely,

Lewis C. Spruill
Lewis C. Spruill
Director

LCS:cja

STATE ENERGY OFFICE
ENERGY CONSUMPTION AUDIT

CODE NO. ____________

SIC NO. ____________

COUNTY ____________

OUTPUT DATA

1. What were your 1973 sales in dollars? ____________

2. What was your 1973 production in units (lbs., etc.)?

   Quantity ____________ Units ____________

3. What was your 1973 average employment? ____________

4. What was your production schedule in 1973?

   Days per year ________ Shifts per day ________ Hours per shift ________

ENERGY DATA

5. Circle "P" for primary and "S" for secondary (i.e., backup fuel used when your primary supply is interrupted) for those fuels you used in 1973 (excluding transportation).

Electricity	1. P	2. S		Fuel Oil	1. P	2. S
Natural Gas	1. P	2. S		Coal	1. P	2. S
LP Gas (Propane)	1. P	2. S		Other	1. P	2. S

   What type? ____________

6. Please estimate the percentage of each type of fuel used (excluding transportation) in 1973 for:

	Electricity	Natural Gas	LP Gas	Fuel Oil	Coal	Other
(a) Space Heating and Air Conditioning	____%	____%	____%	____%	____%	____%
(b) Processing/ Production	____%	____%	____%	____%	____%	____%
(c) Fuels used but not counted in (a) and (b) above	____%	____%	____%	____%	____%	____%
	100%	100%	100%	100%	100%	100%

7. Please estimate your total energy cost in 1973 (excluding inventory changes).

1973 Cost of Energy

Electricity	$____________	Fuel Oil	$____________
Natural Gas	____________	Coal	____________
LP Gas	____________	Other	____________
			____________

8. Please estimate the percentage of your total cost of production represented by your energy costs. ________%

(continued on back)

9. Transportation Energy Consumption in 1973

(a) Please estimate the percentage of each type of fuel used in 1973 for:

	Gasoline	Diesel	Other
(1) On-road use	____%	____%	____%
(2) Off-road use (i.e., forklifts)	____%	____%	____%
(3) Fuels used but not counted in (1) and (2) above	____%	____%	____%
	100%	100%	100%

(b) Please provide the following information on your transportation fuel use in 1973:

	Quantity (in gallons)	Cost (in dollars)
Gasoline	______	______
Diesel	______	______
Other	______	______

10. Electricity Consumption in 1973

Please provide the following information from your monthly electrical bills for 1973:

	Quantity (in kwh/mo.)		Quantity (in kwh/mo.)
January	______	July	______
February	______	August	______
March	______	September	______
April	______	October	______
May	______	November	______
June	______	December	______
			______

11. Did you use natural gas in 1973? (____Yes ____No; if not, please go to question 12.)

(a) The billing procedures used by different gas companies vary; please indicate the quantity measurement shown on your bill.

__________therms

__________c.f. at __________ BTU/c.f.*

__________c.c.f. at __________ BTU/c.f.*

__________m.c.f. at __________ BTU/c.f.*

* If BTU/c.f. is not shown on the bill, please list your gas supplier.

____

CODE NO.____________

(b) Please provide the following information from your monthly natural gas bills for 1973 (Units__________________________):

	Quantity/Mo.		Quantity/Mo.
January	__________	July	__________
February	__________	August	__________
March	__________	September	__________
April	__________	October	__________
May	__________	November	__________
June	__________	December	__________
			__________

12. Did you use LP gas (propane) in 1973? (____Yes ____No; if not, please go to question 13.)

(a) Please provide the following information from your LP gas bills for 1973:

Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
1	__________	7	__________
2	__________	8	__________
3	__________	9	__________
4	__________	10	__________
5	__________	11	__________
6	__________	12	__________
			__________

(b) Storage capacity: ___________gallons

13. Did you use fuel oil in 1973? (____Yes ____No; if not, please go to question 14.)

(a) Please provide the following information for each fuel grade for 1973:

Fuel Grade	Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
No.____	1	__________	7	__________
	2	__________	8	__________
	3	__________	9	__________
	4	__________	10	__________
	5	__________	11	__________
	6	__________	12	__________
				__________

(continued on back)

Fuel Grade	Delivery	Quantity (in gallons)	Delivery	Quantity (in gallons)
No.____	1	____________	7	____________
	2	____________	8	____________
	3	____________	9	____________
	4	____________	10	____________
	5	____________	11	____________
	6	____________	12	____________
				____________

(b) Storage capacity: Fuel Grade No.__________ Gallons_________

Fuel Grade No.__________ Gallons_________

14. Did you use coal in 1973? ____Yes ____No

(a) Please provide the following information from your coal bills for 1973:

Type of coal___________________

Delivery	Quantity (in tons)
1	______________
2	______________
3	______________
4	______________
5	______________
6	______________
	______________

(b) What is the average inventory level of coal you maintain?

____

15. Respondent's Name _________________________Title_________________________

Please return the questionnaire in the enclosed stamped, self-addressed envelope or to:

State Energy Office
Room 145
7 Hunter Street, S. W.
Atlanta, Ga. 30334

APPENDIX C

SAMPLE

VISIT REPORT SUMMARY FORM - FROM IN-PLANT ENERGY AUDIT PROGRAM AND FOLLOW UP LETTER

VISIT REPORT SUMMARY

Company: XYZ Company

Date: 22 January 1975

Company Contacts and Titles: Mr. Red Dye, Plant Manager
Mr. Murphy Dill, Maintenance Supervisor

Visit Team: James M. Akridge, Jack F. Kinney, Walter Hicklin, Richard Sheppard, and Bill Darley

SUMMARY OF FINDINGS

Description of Operations

This plant is primarily a custom carpet finishing plant although some tufting has been added in recent years. Since the finishing plant uses more than 90% of the plants energy, one survey concentrated on this aspect of the operation. Three basic operations are conducted at the plant. These are:

Foam Coating: This operation consists of applying a thin latex precoat, curing with a gas fired infrared over, applying a latex foam and curing in a six module gas fired, hot air oven.

Laminating Oven: This operation consists of applying a thin layer of latex to the primary jute backing, attaching a secondary jute to the latex and curing the assembly in a gas fired hot air oven. The latex bonds the primary and secondary jute together and locks the tufts into place.

Beck Dyeing and Drying: This operation consists of dyeing a length of carpet in a steam heated dye beck. Once the carpet is dyed, it is rinsed, rewet, partially dried with a vacuum extractor and drived in a steam heated, hot air oven.

Once the carpet is coated or laminated, it is trimmed, sheared, packaged and shipped.

Energy Supplies Used

(1) Electrical energy is used to drive the multitude of electrical motors which power most of the plant equipment, lights, exhaust fans, circulation fans, vents and a very small amount of air conditioning (office) also use electrical energy. Consumption in 1973 was 5,039,780 kwh at a cost of $62,331. (2) Natural gas is used to fire two large boilers, a foam precoat oven, a foam dyeing over, and a laminating oven. Steam from the boilers is used to heat air for the wet goods dryer. Consumption in 1973

was 1,500,731 therms at a cost of $85,785. Fuel oil is used as a standby for the boilers. Consumption in 1973 was 1,424,946 gallons at a cost of $167,136. Storage capacity is 90,000 gallons. (3) LPG is used to power fork lifts and for heat in the tufting and yarn mill. Consumption in 1973 was 80,757 fallons at a cost of $14,203. Storage capacity for LPG is 4,000 gallons. (4) Gasoline is used for on road cars and trucks only. Consumption in 1973 was 35,680 gallons at a cost of $11,325. No gasoline is stored.

Raw Materials Used

Raw materials are acrylic fiber, nylon fiber, dacron fiber, polypropylene fiber and backing, jute, latex and dyes.

Energy Dependent Raw Materials

All are expensive, sensitive and energy dependent.

Waste Products Produced

Yarn, selvage, backing, dyes and latex are waste products - 1.5% of total raw products.

Quantity and Value of Wastes

Waste products are 8,600 lb/month of yarn; 6,000 sq. yds. per month of backing, selvage, etc.; 22,500 lbs. per month of dyes and an unknown but large quantity of latex. The yarn is sold to a reprocessor. All other wastes are carried to a landfill.

Energy Potential of Wastes

Moderate potential; backing and selvage could possibly be pyrolized and used as energy sources.

Processes Susceptible to Startup and Shutdown

There are no processes that are susceptible to startup and shutdown if a little warning is given.

Energy Effects on Safety

There is not any special safety precautions that require energy to be used in a specific way.

PROCESS ENERGY UTILIZATION EFFICIENCY AND MAXIMUM POTENTIAL IMPROVEMENT

ELECTRICAL	% Use	% Efficiency	% Improvement Maj.	Min.
1. Electric motors and drives	80	70	10	10
2. Vents, fans, etc.	10	60	0	0
3. Lighting	10	70	10	10
	100%			
THERMAL				
1. Foam Precoater	2	20	45	15
2. Foam Curing Oven	7.9	20	50	20
3. Laminating Oven	8.5	30	30	15
4. Wet Goods Dryer	9.8	20	0	0
5. Becks	65.3	10	40	5
6. Make-up Air Heaters	2.5	80	0	0
7. Plant Heat (other than make up air heaters)	1	70	0	0
8. Yarn conditioners	2	20	0	0
9. Miscellaneous	1			
	100%			

Energy Cost in Terms of Value Added

4.9%

Effect of Energy Cost Increase on Product Price

Price increases must be passed on to the consumer.

Effect of Fuel Cut-back ON Product Price

Cutback in electrical energy would result in a proportional reduction in production. Cutback in natural gas would cause some reduction in production or a change in the oven burners even if alternate fuel were available. If no alternate fuel is available production would reflect the percentage reduction. Trucks have been taken out of service several ocassions because of fuel shortage. If fuel oil is cutback and natural gas is available no production would be lost. If natural gas is not available production would reflect the percentage fuel oil reduction. Cutback of LPG would cause a change in the fork lifts and would cause some reduction in production of both machines and people during cold weather in the yarn plant.

Effect of Energy Dependent Raw Material Cutback

As is the entire carpet industry, operation of the plant is subject to the availability of synthetic fibers and plastic backing materials.

Short Term Alternative Processes for Energy Conservation

Thermal radiation and high velocity drying ovens offer potential for energy savings closed and energy recovery dye beck and continuous dying offer potential for savings. Exothermic foams offer potential for energy conservation in addition to pressurized becks.

Long Term Scheduling Alternative for Energy

Becks, dryers, coaters, etc. can be modified as outlined in the letter to the plant manager.

Short Term Scheduling Alternatives for Energy Conservation

Improved scheduling of dye beck operations to optimize heat recovery from dumped water. Due to the large makeup air needed operation only during warm weather will conserve energy.

Potential Long Term Energy Sources

Solar energy offers significant potential as an alternative energy source.

Potential Short Term Energy Sources

There appears to be no short term alternative energy sources.

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

February 17, 1975

Mr. Red Dye, Plant Manager
XYZ Company
Rome, Georgia

Dear Mr. Dye:

The Energy Audit Team of the Engineering Experiment Station would like to thank you for the courtesies extended us in our recent visit to your plant. We also want to express appreciation to Mr. Murphy Dill for his valuable help. We again want to assure you that all information supplied will be held confidential.

There are many areas throughout a finishing plant where substantial energy can be saved with relatively simple modifications. We have not identified all areas where energy can be conserved, but we did identify the following:

Foam Coating Oven

Analysis of the condition of the air exhaust from each of the modules reveals that very little moisture is contained in this air. Relative humidities were below 10% and typically were below 2%. If the exhaust from each module is ducted to the intake of the following module all the way through the oven as shown in the attached sketch labeled Figure 1, the oven will dry just as satisfactorily and energy required can be reduced by more than 60%. The ducting from each module to the next should be well insulated to minimize heat loss to the plant.

With this design the oven now has only one air inlet and one exhaust. This makes possible the use of a single relatively small heat exchanger to remove heat from module 6 exhaust and preheat the air fed to module 1. Figure 2 shows how this could be accomplished. Use of the heat exchanger will reduce energy consumption by another 10% giving a total reduction of more than 70%.

We believe these estimates to be conservative and have tried to concentrate on modifications which are relatively simple and inexpensive. I would recommend that a non-rotating type heat exchanger be used for the modification shown in Figure 2. Non-rotating exchangers are less expensive and easier to maintain.

Laminating Oven

We knew from the beginning that the laminating oven was more efficient than the foam oven. The question was whether there are inefficiencies sufficient to justify modification. Our measurements indicate that although percentage reduction in energy consumption will be less, substantial savings are possible using modifications similar to those suggested for the foam oven.

Figure 3 shows the initial modification investigated. Analysis of our data indicated that exhaust from module 1 can be fed into the inlet for the next module through module 4. Exhaust from module 4 should be exhausted. The exhaust from module 5 is fed into the inlet for module 6. The exhaust from module 6 is exhausted. These simple modifications should result in a decrease in energy consumption by more than 30%.

With these modifications the oven now has only two air inlets and two exhausts. This makes possible the use of a single relatively small heat exchanger as was suggested for the foam oven. Figure 4 shows the design suggested. In this design the exhausts from modules 4 and 6 are used to preheat the air going into module 5. Use of the heat exchanger as suggested will decrease overall energy consumption by approximately 45%.

As with the foam oven, a non-rotating heat exchanger is recommended. All ducting should also be well insulated as was suggested with the foam oven.

Wet Goods Dryer

Modifications to the wet goods dryer should be exactly as recommended for the foam oven, i.e., the exhaust from each module should be fed to the next module inlet. As with the foam oven, an air inlet on module 1 and an exhaust on module 6 are all that are required. Our tests and calculations show that steam consumption can be reduced by more than 60% with this modification. Figure 1, suggested for the foam oven, also shows the change required for the wet goods dryer.

A heat exchanger as recommended for the foam oven and shown in Figure 2 will decrease steam consumption still further giving a total reduction of approximately 70%. Suggestions regarding the type of exchanger and duct insulation made for the other ovens also apply to the wet goods dryer.

Foam Precoat Oven

Similar decrease in energy consumption of the foam precoat oven is believed possible.

Dye Becks

We checked energy being lost from the dye becks at XYZ to verify our previous measurements. We found that a dye beck with a rolling boil is exhausting over 4,000,000 BTU's/hr. out the exhaust stack. This figure represents approximately the energy it presently takes to drive your wet goods dryer. We also found that a beck was not boiling; either because it is being unloaded, reloaded, filled or hasn't reached boil; exhausts over 350,000

BTU/hr. If it is assumed that six of your becks are boiling and seven are not steaming, over 26 million BTU's/hr. are being exhausted out the stacks. This is more than twice the energy required to drive all three of your drying ovens and does not include the energy lost through hot dye and prerinse water.

I realize that XYZ recovers some of the energy from their dumped dye water, as do most carpet finishing plants. I feel that much more emphasis should be placed on more efficient energy recovery systems due to the magnitude of the energy being lost. Each beck loses approximately 7.3 million BTU's per cycle through dumped dye and prerinse water.

Considerable energy can be conserved with minor modifications to beck operating procedures. Energy lost at boil can be reduced by 50% by using a minimum boil rather than the rolling boil. All of the 350,000 BTU/hr. lost from becks not boiling can be saved by having operators turn vent fans off when steam is not coming off the water surface. This probably could be made automatic with photoelectric controls.

We have repeatedly found becks to be the most energy wasteful equipment in carpet finishing plants. Based on an energy cost of $1.25/million BTU's, 6 becks boiling all the time for 8 hours per day 252 days per year, XYZ could save $30.000 per year by reducing beck losses by 2,000,000 BTU per hour per beck (a reduction which appears well within reach).

Miscellaneous Loses

Need for and use of ventilating fans should be carefully evaluated each day or more frequently. The energy lost through ventilating systems is frequently underestimated or overlooked. Ventilating fans are frequently necessary but, when not needed, operation, especially during cold weather, represents a substantial energy loss which must be made up by other heat sources such as makeup air heaters. A check was made on one ventilating fan at XYZ. With an outside temperature of 55°F, as it was the day we checked; the fan was exhausting over 600,000 BTU per hour. If the outside temperature had been 32°F at a relative humidity of 60%, the loss would have been over 1,400,000 BTU per hour.

Boilers

The efficiency of the steam boilers was checked. Boiler number 1 was found to have an efficiency of 85% on low fire. Boiler number 2 was found to have an efficiency of 79.5% on medium fire. The efficiency of boiler number 1 is excellent while that of number 2 is a little low. The difference in measured efficiency may be due to the different level of operation, although boilers of this type typically show 80-82% efficiency at high fire.

Again, I would like to thank you for the excellent cooperation XYZ extended. I hope you are able to put some of the recommended changes into effect and can realize the potential savings there. If we can be of help, please call on us.

Sincerely yours,

James M. Akridge
Senior Research Engineer

JMA:rh

Enclosures

APPENDIX D

IN-PLANT CONSERVATION AND MANAGEMENT CONFERENCE AND WORKSHOP MATERIAL

IN-PLANT ENERGY CONSERVATION AND MANAGEMENT CONFERENCE

CONFERENCE SCENARIO

Welcoming Remarks — Local Representative

Program Orientation — Conference Coordinator

Thank you for your hospitable and pointed remarks. The Georgia Tech team is here today to confer with Industrial Managers in this area because we believe that business and industry must make a profit to stay in business. To make a profit, business must be competitive. The continuing rise in the cost of energy and unpredictable supplies of fuel have created a new dimension in business management at a time we are currently facing a decline in economic activity and general inflation in most sectors of the economy.

We believe that you are here today because you want your company to make a profit and stay in business. We believe that savings on energy can assist you in reaching this goal. This conference on in-plant energy conservation was designed to help you place into proper perspective your energy problem; to illustrate that opportunities exist for energy cost reduction, for example, to furnish you guidance in establishment of in-plant conservation and management programs. The agenda for our discussion today is outlined on this visual aid (show visual aid #1).

We are quite aware that many of you are sweating blood to keep your plants operating, and to many of you the energy situation is just one other problem with which you must deal. Cost is probably foremost in your mind when thinking of energy, yet there must be a nagging worry in the back of your minds that all is not well in this country insofar as energy is concerned. It is no secret that foreign interest have us over the barrel insofar as petroleum is concerned. So first let's take a quick look at our energy situation from a national viewpoint.

In the early 1970's the energy situation in the United States changed from one of domestically produced surplus to scarcity. The change, predicted by experts some years earlier, was not sudden or dramatic. To most Americans, it was almost imperceptible.

The results of that change, however, have been dramatic. In October 1973, the Arabs demonstrated America's vulnerability (and that of most of the rest of the industrialized world) to an embargo by the oil producing nations. Now--energy costs are up--in some cases many-fold; energy supplies are uncertain and in the case of natural gas, totally unavailable to many would-be consumers; the electric utility industry is facing serious financial problems, and while most consumers do not have to fear cutbacks, the utilities outlook for the future is, at best, uncertain. In fact, the outlook for our entire energy future is uncertain and clouded by conflicting judgment as to the nature of our energy problem, its seriousness, and what to do about it.

The film we are going to screen is designed to put our energy problem into perspective, to demonstrate the dimensions--the orders of magnitude--of the efforts required to meet our future energy needs.

<u>ENERGY: The Critical Choices Ahead</u>

> An 18-minute, full color motion picture with voice-over narration which depicts the present U.S. energy supply situation and its equally serious long-term implications. It points to steps that must be taken to meet this situation.

If the past is prologue, any projection of U.S. energy demand to the year 2000 which is made now will almost certainly be proved wrong well before the end of the next decade. But, if we are to understand that nature of our energy problem, we must form some idea of the orders of magnitude involved.

We began by analyzing the economic forces in our society that make for energy consumption in order to establish "A Projection" of future demand that would reflect what would happen if future conditions were essentially the same as past conditions. This process was repeated for "Projections" of energy supply, although account was taken of higher energy prices. Beginning with these "Projections" as reference levels, we made a series of assumptions about future conditions, and adjusted the reference levels to reflect the impact of these changes on future demand and supply.

Therefore, in the "Scenario" posed in this film it is vital to understand that we are endeavoring to present the "Dimensions" in which our energy future must be viewed, and that we are not attempting to forecast or project an exact rate of growth of demand or an exact relationship among possible sources of supply.

The probability is that our U.S. energy barrel in the year 2000 will be quite different from any of those discussed above. Indeed, to an important degree the magnitude and composition of both energy demand and supply will depend heavily on the perception of the problem by the government and the policies and programs that evolve from that perception. Of equal importance is the comprehension of the problem by the public and the resulting support for government actions to improve the situation. It is hoped that the film you have just seen will make some contribution to meeting both of these objectives.

Not withstanding the factual information presented in the film, we average citizens are somewhat confused. We see little evidence at the moment that we are actually in an energy shortage crisis other than the price of gasoline is high; electric bills are really hitting us, and natural gas is in short supply. We are in a period of reduced economic activity with a poor job market and inflation is not under control. Many of us do not fully understand the implications of an imbalance of international payments on our economy.

In this introductory phase of our conference we have attempted to review the energy situation with you and to set the stage for further discussion of improving the profit situation in your companies through energy conservation and management. We will discuss with you the role that the state energy office is playing with special emphasis on the current energy situation in Georgia. Following this, our engineering and management team will present the essential elements of in-plant energy conservation and management and ways and means of actually establishing such programs in your plants. We will then enter into a period of question and answer discussions.

State Energy Policies and Services of the State Energy Office — State Energy Office Representative

Georgia ranks 35th among the states in net energy consumption per capita using 222 BTU per capita in 1972 and slightly less than that in 1973. Total net energy input in 1972 was 1,051 trillion BTU; preliminary figures indicate a net input of 1,007 trillion BTU for 1973. (Show visual aid #2).

For a few minutes let us see how Georgia compares to the rest of the country in its consumption of energy and fuels. When compared by economic sector (show visual aid #3). Georgia uses less energy in the residential/commercial sector that the U.S. average is 14% to 20%. This may be attributed to the fact that we have milder weather than some other parts of the country. Our industrial consumption is also less than the natural average, 19% to 28%. Georgia does not have some of the big energy using manufacturing process as are found in the northen and mid-west states. On the other hand we expend considerable more energy in the transportation sector, 37% to 25%. Georgia is a nonmetropolitan state and Georgians use private conveyances much more than other states who have mass transit facilities. Also, Georgia is a transportation center in the southeast. With respect to electric generation, Georgia useage is about average with the rest of the country.

As you can see on this chart (show visual aid #4), Georgia consumption of fuel resources compares very closely with the rest of the country.

The Economy

During this past winter we have been fortunate that Georgia has not experienced the natural gas curtailment problems that some other states such as North Carolina, Kentucky, and New Jersey have had. Only one of the three pipelines serving the state has had any difficulty. However, this does not guarantee us that we will not have problems in the future. More and more reports are being released that indicate our natural gas production has peaked out. This does not pose an immediate threat to our state; but, due to our heavy dependence on natural gas, particularly in the industrial sector, we need to start using our natural gas more efficiently to make it go further.

We are still operating under the emergency petroleum allocation act of 1973. In essence these regulations provide for industrial customers to receive an allocation of 100% of their current requirements (as reduced by an allocation fraction) for process use and 110% of base period use (as reduced by an allocation fraction) for space heating. Space heating requirements will be supplied at a minimum of 88% of base period use. At the present time almost all suppliers have an allocation fraction of 1, therefore firms are being supplied at 100% of their needs.

Although a national energy policy has not been set, the President and Congress have been moving towards such a policy. First let us look at some of the President's proposal as of March and April of this year. (review visual aid #5.)

As you know, the Congress has been putting forth many alternative suggestions. Some of them are outlined in this chart (review visual aid #6).

What do these policies mean to us in Georgia? First, the deregulation of old oil could mean an increase of 13¢/gal. for gasoline and 7¢/gal. for middle distillates. Based on 1973 consumption figures this would cost Georgia approximately $400 million. The $2/BBL excise tax could mean an increase of 8¢/gal. for gasoline and 5¢/gal. for middle distillates. This would cost Georgia approximately $270 million. The two actions combined would increase gasoline by 21¢/gal. and middle distillates by 12¢/gal. If the total increase is passed on to gasoline it would increase gasoline by about 26¢/gal.

The President estimates that deregulation of new natural gas would raise the consumer's price from 31¢/MCF in 1974 to 35¢/MCF in 1975; 38¢/MCF in 1976; and 40¢/MCF in 1977. On top of this he wants an excise tax of 37¢/MCF. Based on 1973 consumption figures this 41¢/MCF price increase would cost industrial consumers in Georgia about $71 million.

We can see that energy costs are going to increase significantly; if not immediately, over the next few years. Therefore, it would behoove us to start serious energy conservation programs now. If we don't start a voluntary program now we can be assured that mandatory conservation programs are coming: they have been mentioned as part of almost all the proposed energy packages.

Before I leave the podium today, I would like to say a few words about our office and what its functions are. Our mission is to ensure as well as possible that no Georgian sustains unnecessary hardship for lack of fuel or other form of energy and to prevent any significant instability or deterioration of Georgia's economy due to lack of energy. In carrying out this mission we administer the Emergency Petroleum Allocation Act of 1973 in Georgia, we also collect and maintain information on energy needs and supplies within the state so that we can provide advance warning and take appropriate preven-preventive or corrective action on significant shortfalls.

Our office is shifting its emphasis from fuel allocation to energy management and conservation. We are here to help you in any way that we can; please give us a call.

In conclusion let me say even though the energy supply situation looks good right now, we import 40% of our oil and with the current unstable conditions in the Middle East who is to say that the oil will not be cut-off again. I hope we learned our lesson last year and that we will take positive steps to use our scarce energy supplies more efficiently.

Transition to Engineering Approaches — Conference Coordinator

Thank you Mr. Bonham. It seems that for the moment we Georgians are in fair condition insofar as the short-term energy situation is concerned, except for the matter of cost and the possibility that our supply of petroleum can be cut at almost any time. However, we must look further down the road. The objective on any in-plant energy and conservation and management program should include the following: (show visual aid #7.)

- Increase profits by saving on energy costs
- Prevent business of plant shut-down due to energy shortages
- Keep people working
- Keep U. S. industry competitive
- Keep U. S. industry as free from government control as possible

I'm sure you will recall that, until the economy began to decline, we were in a period of tight energy and energy related materials shortages. The economic decline in the building, automobile and textiles industries has been accompanied by an easing of demand for energy and energy related materials. When we begin to recover from the current period of economic decline, how far can we progress before we again run into the energy and energy related materials barrier. Can we overcome the barrier initially through improved efficient use of energy, or will it be necessary for the Federal Government to impose controls on the utilization of industrial energy. Now, for a few minutes let us examine the basic nature of industrial energy.

According to traditional industrial location theory in the United States, energy is a crucial location factor for relatively few industries on initial siting. The cost of energy has primacy in the production of basic chemicals, primary aluminum, and electric furnace operations for ferroalloys and some refractory materials. It has greater-than-average importance for pulp and paper, malleable and ductile iron castings, the rolling of nonferrous mill products, meat packing and steel production.

When considering existing industry, the theoretical economist tends to measure the cost of energy as a percent of total manufacturing costs. In contrast, the businessman thinks of absolute costs and cost differences. To put the matter in another way, a difference in the cost of $2,000 a year can have far greater significance for him than the percentage this represents of his total manufacturing costs.

The demand for, and form of, energy used in any given industry will vary according to the requirements of the processes involved and the cost of procuring supplies. Energy is demanded in different forms by different industries. In some, the main demand is for heat, and in others, it is needed mainly to provide a force to drive machinery or to move materials and products. In others, it may be required for chemical and electrolitic processes. Finally, energy may be an important element in the feedstock used to manufacture a product. In others, it may be required for chemical and electrolitic processes. Finally, energy may be an important element in the feedstock used to manufacture a product. In meeting energy requirements, an industry may be able to choose among alternative sources.

For the past six or seven months, teams of engineers and industrial management personnel from the Georgia Tech Engineering Experiment Station have been involved in preparing detailed energy profiles for Georgia's business and industry, company by company. Energy audits have been made in selected plants to determine:

- What energy supplies are used, and how energy flows through the plant
- The raw materials used, and how they are energy-dependent
- What waste products are produced, and their potential for energy production
- What processes are susceptible to start-up and shut-down losses
- What specific safety precautions, if any, require energy to be used in specific ways

We are prepared to discuss the use of energy within plant as to purpose and efficiency: to discuss alternatives for energy conservation, including process, scheduling, and fuel alternatives categorized as to short and long term, and to describe the expected economic impact of suggested changes, including costs and time-frame for implementation. The engineering team is prepared to discuss ways and means of putting in-plant conservation programs into action. Finally, we are prepared to furnish some training for your personnel through an energy workshop which is described in the materials in your folder.

Engineering Approaches to Energy Conservation — Engineering Team Member

This phase of the conference is concerned with engineering approaches to energy conservation. Here we are concerned with the more technical aspect of energy leading to a sound in-plant program based on sound engineering that meshes well with management. My remarks are covered to some extent in the handout included in your folder entitled, (Handout #1). First I would like to discuss some basic, fundamental ideas and concepts involved in energy conservation. When speaking of energy conservation in context with inplant usage of energy, I am actually considering the efficient use of energy. My colleague, Mr. Munoz will then outline and discuss with you ways and means of developing and installing the in-plant energy conservation program. I will then discuss some energy conservation opportunities that exist in many plants and give some examples illustrating where energy savings have been made.

Now let us identify some basic considerations involved in the industrial use of energy. One way to view energy is to think of it as a commodity. One can think of energy as a supply that must be available and used in the manufacturing process. Like any other commodity of supply element we must be able to define and measure it. We must be able to account for it as we account for other elements in the productive process. We must understand how we are using it and have some economic basis for evaluating it.

One universal term used in energy measurement is the BTU--British Thermal Unit. One BTU is the amount of energy used to raise one pound of water one degree farenheight.

Generally, our energy comes primarily from basic fuels. Some of the basic fuels are shown on this chart (show visual aid #8). Here are some fuels that are in common here today. Coal, Number 2 Oil, Number 6 Oil, Natural Gas and Propane. The approximate energy contents in terms of BTU of these fuels. We listed here individual values which vary somewhat with the quality of fuel, but basically coal has about 14,000 BTU's per pound. Number 2 oil--140,000/gal., number 6 about 150,000/gal. Natural gas runs normally from 1000 maybe to 1,030 per cubic foot. We've shown in the table, in terms of therms which is just another definition of a unit of energy. A therm is 100,000 BTU's. Generally when you buy gas, your purchase is measured in therms. Propane runs about 19,000 BTU's per gal. Those are some fairly realistic prices, I think. Again, it varies depending on the quality and quantity of the fuel you buy. Coal, now costs about $30 a ton. Some old contracts for coal run about $20 a ton with number 2 oil, number 6 oil running about those current prices. Natural gas varies considerably as you know, depending on whether you are on uninerruptible or interruptible service and on the amount that you buy. I think a reasonable figure for a fairly large amount of natural gas is about 7¢ a therm and propane now is running about 33¢ a gallon. Based on those figures, here are some relative costs, of the various fuels, in terms of the BTU content. What's that? About $1.07 and my M BTU stands for a million BTU's. You might be used to M standing for a thousand, but M here means a million, so it's about $1.07/MBTU and so forth. So those are our basic fuels and where we get most energy.

Now that we have viewed the unit of measure (BTU) that is most commonly used and examined the energy value of some fuels, let us take a further look at some basic coordination (show visual aid #9).

Now, what do we use our energy for, in-plant? We purchase fuels and we use those to convert into some other form of energy. We find it convenient to break down our energy use into 4 categories: (1) basic heating and air conditioning, (2) the second, we say is to produce a utility. By a utility we mean some item, some quantity that in itself is probably not an end-product, but is just converting the energy into a more convenient form or is subsequently used in the processing, and by utilities we've listed here, electricity, steam, air, water. Probably none of you produce that in your own electricity. You purchase that, but it really is a utility in the sense that basic fuel was used to produce that item. Probably most of you have boilers you produce steam in your plant, or maybe compress the air or maybe heating water or something like that. That's another use of your basic fuels. Third category is a direct use of the fuel, such as in a direct use in a process; for example, ovens or dryers. And finally, you use energy in transportation.

In order to account for our energy, and to evaluate the significance of the energy, we feel that one basic idea that is really worthwhile getting used to is the concept of equivalent energy value. The equivalent energy value is the total value of energy in BTU's of all fuels consumed in producing a utility or product (show visual aid #10). Now everything that you do in your plant, every utility that you purchase or make, every product that you make has an energy value just like it has a dollar value in raw material. Or it has something else--an equivalent energy value. We need to start thinking in terms of what an equivalent energy value is. So that different kinds of energy can have a common base. Now the energy equivalent value is the amount of energy associated with the fuel, the basic fuel, that was consumed to produce it, and here are a couple of examples: one is electricity, you purchase a utility--electricity, when you buy a kilowatt hour of electricity, you are purchasing 3,412 BTU's basically, because a kilowatt hour is equivalent to 3,412 BTU's. If you take electricity to run a motor or heat with it, that's what you are going to be able to get out of that BTU. However, for the power company to produce that kilowatt hour of electricity, they have to burn about 10,000 BTU's of fuel to produce that kilowatt hour. That number varies somewhat. So we would say that a kilowatt hour of electricity has about 10,000 BTU's equivalent energy value.

Another example might be steam. Maybe you are producing steam in your plant which would be a utility you are using for processing or maybe for heating or maybe for something else. As an example, suppose you have a boiler and you are putting in 60 degree water and you are generating 125 lbs. per square inch, 344 degrees saturated state. In order to do that, in order to take that 60 degree water, a pound of it, and raise it up into saturated steam at 125 lbs. per square inch, you are going to put in 1,164 BTU's. However, there is no thing such as 100% efficient boiler. So suppose that boiler was 80% efficient--that's a reasonable figure. Really what you would have to burn in fuel would be 1,456 BTU's. In other words, you would have to burn 1,456 BTU's of fuel to produce steam, in which you'd really only put in 1,064 BTU's per lb. So we would assign to that pound of steam, we would say that lb. of steam has an equivalent energy value of 1,456 BTU's. And you can apply this definition, this concept, to anything. Any product that you produce for utility, you can assign an energy value to. Any raw material that you buy, you can assign an energy value to, and what that energy value is depends on the fuel somebody had to burn to make it. This is a valid concept, because it gives us a base, it gives us a working definition to evaluate the energy intensity of anything that we are doing. In other words, it really has two basic uses, and I think that one is: It does identify products or utilities that are very energy intensive. Those that have a high BTU content are energy intensive. That means that, say raw materials that you might purchase are very energy intensive, that means as the energy situation gets worse they are going to become scarce and they are going to increase in price. It gives you a way of comparing your energy consumption in producing a product, compared to somebody else, or with industry averages. It'a also a good basic definition to apply your own energy conservation program. One simple way is to take the amount of fuel or equivalent to the energy you consumed in your plant use a stated period of time divide that by the number of items and production. This will give you the BTU content per unit of production.

Energy has a dollar value that is simply the cost of the fuel to produce your utility or product. Suppose your steam boiler is producing 125 PSI, 344 degrees steam. We said that steam had an equivalent energy value of 1,456, because that was the fuel that had to be consumed to produce it. Again, suppose that you are purchasing natural gas fuel and you are paying 70¢ MBTU's. By computation you determine that the steam has a value of $1.02 per thousand pounds. In other words, every thousand pounds of steam you produce is costing you a $1.02 based on an 80% efficient boiler. In working that out, it is convenient to put it on a BTU basis, so I have also put it $1.02 per thousand Lbs. I've also put it on a BTU basis of 88¢ per MBTU, simple by taking the $1.02 per thousand Lbs. and dividing it by the BTU in that steam, which was the 1,164 per lb. You might wonder what's the difference between the 88¢ per MBTU value I put on my steam and the 70¢ per MBTU value paid on my fuel. Well, again that reflects 80% boiler efficiency. In other words, to produce that pound of steam, it costs you 88¢ per MBTU.

Developing and Installing the In-Plant Energy Conservation Program

Engineering Team Member

A sound program must be based on valid objectives. You will recall that the conference coordinator set forth the following objectives for the in-plant program which is the subject of this conference. These objectives are:

- To increase profits by savings on energy costs
- To prevent business or plant shutdown due to energy shortages
- To keep people working
- To keep U. S. industry competitive
- To keep U. S. industry as free from government controls as possible

When we started to prepare this conference I was reminded of a variation to certain scientific laws which students sometimes refer to the three laws of thermodynamics. One version is as follows:

- The first law states that you don't get something for nothing
- The second states that things are going to get worse before they get better, and
- The third law states that things are not going to get any better.

These laws apply in the current energy situation, therefore it behooves us to prepare for the approaching scarcity of fuel. The program handout No. 2 which is in your folder outlines a program for in-plant conservation and management. I want to cover this matter in sufficient detail so that we can discuss it more fully during the question and answer session. The energy conservation and management program comprises four steps or stages:

1. There must be a top management commitment
2. There must be a survey of energy uses and losses
3. In-plant energy conservation actions must be implemented, and
4. Continuing energy conservation efforts must be developed and maintained.

For the next few minutes I want to comment briefly on each of these points. Let us begin with the management commitment.

The first part consists in having the top management committed to the program. It is more important than it sounds, for without top management committment there's no program, just empty words. Top management has to be convinced there is a need for the program, and the top management has to support it with money and time. There are several steps in the first part of this stage. First the plant manager should call on all the line supervisors and explain the need to conserve energy, and tell them the important steps that have to be taken to conserve energy. Management has to inform them that the burden of conserving energy rests with them. The men in supervision are the ones that make the company produce, and they are the ones that will make the company produce in the future through their normal duties, and through special attention to conserving energy.

The next action is to set up an energy conservation committee. In a large company, committee membership will usually consist of department heads, and the plant manager will serve as a coordinator. It is desirable that the maintenance department head serve as the energy coordinator. In a smaller plant, it may work out better to have as energy conservation team the plant manager and his maintenance man. In some instances it may be necessary to employ consultants to set the program up. The point is that there has to be one man or a group of people in charge of conserving energy and responsible for the program.

After the committee has been established and duties are assigned, the next step is to develop energy conservation targets. These targets or goals may be arbitrary or they may be based on an energy survey of the plant. For example, how much can we save by going through the plant and taking care of all the things we see that are wasting energy? It will be necessary to reassess that goal later on, according to what are the realistic goals of the company. Usually 10% savings may be a good starting point.

Once these goals are set, and the committee is at work, you must communicate with your employees, because they are the ones that can make the program a success. You should not be afraid to use outside consultants, if you don't have the necessary in-house know-how to do a decent job.

The energy survey should be developed by the energy conservation committee. There are two types of energy surveys needed. The first one consists on the location of obvious energy losses in the plant. For example, leaking water valves, steam pipes that have lost their insulation, holes in the wall where some valuable heating is being lost, equipment or lights on when they are not needed; furnace boilers out of adjustment. These are types of losses that can be expected to be found in this first survey. These are the type of things that can be corrected immediately by maintenance people.

The second energy survey may involve the determination of need for additional energy measuring equipment. Can you justify such equipment? This equipment may be essential to identify and develop an energy balance for each process in your plant. Using such an approach, you can then determine how much energy is added in each step of the process. To have this information is to be in a very knowledgeable position. You can answer questions of this type: Can you recover waste heat to generate steam? Can you use waste heat to heat the raw material, or your product? (Later we will give an example in which a carpet plant is using some of the waste heat to help dry the carpet in the final stage); Can the process be modified or a process step eliminated to reduce energy? Can an alternate raw material with lower energy content be used? This is an extremely important and challenging question. In many cases, it can be answered yes. But you really have to be in possession of accurate data to arrive at a correct answer. Some examples are as follows:

Polystyrene foam chips are used for packaging some types of delicate instruments, or fragile types of merchandise. You can substitute popcorn for it, or wood shavings if you so desire, and those are two types of packaging material with lower energy content than polystyrene. An energy conscious manager knows that there will be a time when polystyrene will not be available for such use. Another example could be the substitution of a plastic handle for a wooden one. Of course, this is an oversimplification because the molding process is very cheap at this time, but the time in which the raw materials to make the plastic may not be available due to the cost are already here and this is the type of thinking that we want to impress upon you. Can you imporve the yields of your processes? Can you justify the need for a new piece of equipment that will save energy? Can you schedule three 24-hour shifts instead of two 8-hour shifts 5 days a week, for example? One last point in the second stage of this program is that you have to check closely specific systems within your plant--the steam system, for example, carefully. Condensate water is good water for the boiler, because this water is of an extremely high purity which can be especially important in parts of the state where the water is of high hardness. Other systems such as the compressed air and electric systems--what can be done in terms of saving energy in these cases? In the textile industry, for example, there is a problem in terms of electrical motors. In the days of cheap energy, most mills equipped their looms with higher duty electrical motors than they really needed; consequently, these motors are not working efficiently. The textile manufacturers found how inefficient these motors were through energy surveys. These are the types of things you should expect to find and learn from the energy survey.

After your energy surveys are complete, and you have been able to answer these questions, you can execute the third stage of this program, and implement the energy conservation measures. The first item, of course, will be to have your maintenance department correct energy losses that were detected in the first run through the plant; then list and discuss all of the energy conservation projects that have come up through the ranks from employees, from supervisors as well as ideas obtained from reading publications such as the EDICT handbook; or techniques that we may have suggested through workshops; whatever is available through the State Energy Office, etc. These are the types of ideas that should be looked at in this third phase.

Once this information is spread out on top of the table, evaluate and select projects for implementation. One good way to choose promising projects is to apply measures of performance, such as "pay back period" or "return" of investment". We will later present an example of an installation of an economizer: the installation of an economizer in a boiler illustrates a pay back period of a little bit over a year--it is really worthwhile. To conclude this third stage, review the designs of all your plant additions, expansions, buildings, to be sure that efficient utilization of energy is part of the design. In other words, when you have learned the lesson--use it. The last stage of the energy conservation program consists of developing continuing energy conservation efforts. To me, this is the most difficult and worthwhile part of the whole program, because after you have done some work in your plant, after you have eliminated a lot of the little things, or big things that were wrong with the plant, there is a natural tendency of human beings to sit back and be complacent with the work done so far. And that's the time that you have to really watch what you are doing, and continue the program. It's just like this story of the golfer that went to the tee--and he was a really bad golfer--there was an anthill at the tee, and the golfer attempted to hit the ball and he was slicing turf, right and left and couldn't hit the ball, but was killing ants. One of the ants saw his father, his mother, and all the cousins, about 3/4 of the family dead and he pokes one of the other ants in the ribs and says, hey, let's get on the ball, if we are going to survive. And that's the whole point of this program. You really have to get on the ball in this fourth phase. The first step in this stage includes measuring the results that you have obtained, chart the energy use per unit of product, per department. Compare the amount of energy that you were using in the past, with the amount that you are using now, and with the theoretical amount of energy that is necessary to produce your product. If you have that information, you can start finding out how well you are doing. For example, in the cement industry through the use of the wet process it takes 1,200,000 BTU's of energy to make a barrel of cement. Their new processes, as exemplified in the cement plant at Clinchfield, Georgia, is producing cement through a newer system which includes a very good heat utilization system. They are producing cement there at 600,000 BTU's per barrel. The theoretical amount of energy necessary to make a barrel of cement is in the neighborhood of 400,000 BTU's. So, the cement industry is getting closer to the theoretical. This is the type of thing you will be able to do, to assess how well you're doing. You don't even have to compare your operation with other plants. I mean, you will know how good you are, having that information. With that information in hand, you can identify and correct causes for increases that may occur in energy per unit, and then evaluate the overall program and review progress and revise goals if it is necessary.

Simplify the program, if you have to. It is very important to maintain the momentum of the program, through periodic energy savings, communication to develop awareness for energy conservation and let everybody in your plant and in your community know that you are saving energy, that you are making sure that they will keep their jobs. You are educating them not only for the benefit of the company staying in business, but also for the benefit of the community, state and the nation. Involve your employees in the program. This is just sort of a suggestion of what you can do to inform your employees on the job. You can use posters: very vivid, with a lot of color to ring a bell within them. Energy saving check lists should be developed and placed in strategic locations to remind employees of appropriate actions to be undertaken such as shown on this chart (show visual aid #11).

Special programs should be developed to encourage employees to involve themselves in the energy conservation program. For example, a company in Carrollton has an employee program which involves the "Southwire Buck."

They are awarding a dollar to anybody who presents a good idea for energy saving. If the idea is a really good one that can be implemented, additional rewards are given.

The employee education workshops should be continued, especially for supervisors. Finally, provide guidance and assistance to the employees in practicing energy conservation at home and elsewhere.

Now, we have discussed the four steps involved in the program: the four points are--have the top committee of management survey the plant energy uses and losses; implement energy conservation actions; and develop continuing energy conservation. Now, let's see how you can all help by identifying energy conservation opportunities.

Energy Conservation Opportunities — Engineering Team Member

Opportunities exist in almost all plants to increase the efficiency in the use of energy. When we conduct our workshop in a few weeks we will spend considerable time with you investigating specific approaches and actions that can be taken to conserve energy. Within my time allocation today, I can only outline these approaches and cite some specific examples where savings have actually been made.

As I list the various opportunity areas within plant where energy conservation opportunities exist, I suspect your reaction will be that I am telling you nothing new. That is true, however, we want you to give some thought to these areas. Our list includes:

- Buildings and grounds
- Electric power
- Steam
- Other utilities
- Heat recovery
- Heat confinement
- Combustion
- Scheduling
- Material handling
- Shipping, distribution, and transportation
- Process changes

As was mentioned earlier one of the first actions to be undertaken is the energy survey. As shown on this chart (show visual aid #12) all utilities and fuels purchased should be identified. (Review and discuss chart). The energy survey is of course much more comprehensive than this element. It will depend to some extent on the size of the plant and the type of process involved.

There are four stages involved in increasing the efficiency of energy uses as shown on this chart (show visual aid #13).

First off, we want to eliminate unnecessary use of energy. Lights on in areas not in use and air conditioning in storage areas where not required, as examples. Although these are the easiest and least expensive things that can be accomplished, they won't be done unless someone takes positive action. Also the action must be continuous.

Secondly, we want to eliminate obvious losses such as lack of proper insulation on steam pipes and air conditioning ducts. Holes in the roof and broken windows are also common examples of obvious losses of energy.

The first two steps can usually be done with in-plant personnel and with little expense. Additional actions will usually require some engineering assistance. New equipment may be required. In fact we can reach the point where we may need additional research before we can find ways of using unused energy.

After the obvious and unnecessary wasteful energy losses have been corrected and a continuing program have been instituted to maintain an efficient program, we enter into an area requiring analytical work and good engineering. It is in this area that costs and capital investment are involved. Pay-back periods must be reasonable if profitable operations are to be maintained.

A first step in this area is an analytical one. Initially energy flow diagrams should be developed for total plant operations as well as for specifics. Such diagrams are shown on the following visual aids (show visual aid #14 and #15 and discuss).

As I mentioned earlier, there are many ways and many opportunities for energy conservation in most plants. We will discuss some of these in detail during the technical workshop. At this time I want to illustrate three cases that will demonstrate the techniques involved and the fact that energy saving can be achieved in-plant at reasonable costs in terms of pay-back periods. (Show visual aids #16, 17 and 18 and discuss).

Conduct of Question and Answer Conference — Conference Coordinator

Work is underway at Georgia Tech to assist the Federal Energy Administration to develop ways and means of monitoring in-plant energy usage. Although our studies are not complete, we are convinced that the measuring of in-plant energy flows is not simple and that there is a need for engineering technology assistance made available to many plant managers if they are to fully develop an efficient system for managing their energy consumption. Additional work needs to be done in developing appropriate instrumentation for measuring energy flows. There are classes of energy problems within industry groups that can be solved eventually for the industry group. We are also aware that, for the foreseeable future, cost differentials and savings cannot be the only force motivating management to conserve energy. Other incentives must be brought into play.

For the last two hours we have reexamined the national and international energy situation as it can affect you as industrial managers. We have seen that our current situation in Georgia is satisfactory at the moment with exception of cost factors. We have looked at engineering applications and ways and means of establishing in-plant energy programs. Following a short break.

Remarks Concerning Question and Answer Sessions

The question and answer sessions offered both the conference presentors and the participants an opportunity for the exchange of information. Technical questions were answered if they could be answered within a reasonable period of time. Otherwise it was suggested that the question be answered during the technical workshop.

TECHNICAL WORKSHOPS ON ENERGY CONSERVATION

The full-day workshops were presented for plant maintanence and technical personnel to aid them in setting up energy conservation programs and identifying conservation potential. A typical agenda for the workshop was as follows:

I INTRODUCTION
II THE GEORGIA TECH ENERGY CONSERVATION PROGRAM
III CONDUCTING AN ENERGY AUDIT AND SURVEY
IV PLANT HEATING, VENTILATING AND AIR CONDITIONING
V COMBUSTION AND HEAT RECOVERY EQUIPMENT
VI ELECTRICAL EQUIPMENT.

The agenda was established in order to keep the program flowing but was not intended to be rigid. Each topic was handled primarily by one individual of the panel but the floor was open at all times for questions and responses from any participant. The general approach was for a panel member to present a broad coverage of a specific area attempting to determine if there were particular points of interest and to stimulate discussion of some technical problem. A more detailed outline of the topics discussed is given below.

I. INTRODUCTION

a. Forms of energy and common units.
b. The measurement of energy.
c. Conversion of energy from one form to another and conversion losses.
d. Our sources of energy.
e. Energy content of various fuels and the cost of energy.
f. In-plant uses of energy.
g. Methods of conserving energy.

II. THE GEORGIA TECH ENERGY CONSERVATION PROGRAM

a. The pattern of energy use growth over the past several years.
b. The economic demand for energy conservation.
c. The energy program and the need for top administrative support.
d. Energy conservation by controlled lighting.
e. Energy conservation by controlled heating and air conditioning.
f. The role of maintanence and good record keeping.
g. The new energy engineering approach for identifying energy conservation opportunities.

III. CONDUCTING AN ENERGY AUDIT AND SURVEY

a. A basic for energy accounting; the energy content of a product or utility.
b. Subdivision of plant and processes. Identifying energy and material flow.

c. Conducting an energy survey.
d. Identifying short term and long term conservation opportunities.
e. Establishing the energy content of a product or utility.
f. Setting up a continuing energy conservation program.

IV. PLANT HEATING, VENTILATING AND AIR CONDITIONING

a. Characteristics of heating, ventilating and air conditioning systems.
b. Measurement and calibration of systems.
c. Maintenance of systems.
d. Increasing system efficiency by operation.
e. Increasing system efficienty by modification.
f. Reducing load requirements on system.
g. Considerations in new system design.

V. COMBUSTION AND HEAT RECOVERY EQUIPMENT

a. Identifying and repairing leaks.
b. Importance and use of maintainence and records.
c. New developments in equipment design.
d. Water to water heat exchangers.
e. Air to air heat exchangers.
f. Precautions to observe in recovering heat from combustion products.
g. Measuring combustion efficiency.
h. Care and maintainence of combustion equipment.
i. Characteristics of boilers.

VI. ELECTRICAL EQUIPMENT

a. Electric motor characteristics and matching of motor to load.
b. Significance and correction of power factor.
c. Efficient lighting.
d. The structure of power company rate schedules.
e. Electrical demand control.

Handout No. 1

ENGINEERING APPROACHES TO ENERGY CONSERVATION

BASIC CONSIDERATIONS IN ENERGY USE.

ENERGY SURVEY AND USE ANALYSIS.

INCREASING EFFICIENCY OF ENERGY USE.

BASIC CONSIDERATIONS IN ENERGY USE

1. Unit of energy is the B.T.U.

2. Our energy comes primarily from fuels; coal, natural gas and petroleum products (see table).

3. Uses of energy are:

   a. Plant space heating and air conditioning

   b. Produces a utility; such as,

      Electricity

      Steam

      Air

      Water

   c. Direct use in a process; such as,

      Dryer

      Oven

   d. Transportation.

4. A basic and useful concept is "Equivalent Energy Value" which is the total value of energy in B.T.U.'s of all fuel consumed in producing a utility or product.

   EXAMPLES:

   1 kwh of electrical energy will yield 3412 B.T.U.; but "EEV" = 10,000 B.T.U.

   125 psi, 344°F saturated steam will yield 1164 B.T.U./lb, if condensed to 60°F water; but "EEV" = 1456 B.T.U./lb. if produced in a boiler of 80% efficiency.

   A product ....

   Raw materials ....

This concept useful:

a. As an indicator of the energy intensity of a product or utility

b. As a measure of energy consumption and energy conservation

Determined by

$$\frac{\text{Total "EEV" consumed in some time period}}{\text{Number of units produced in time period}}$$

Another concept is "Energy Dollar Value" of a utility or product. It is the cost of the "EEV".

EXAMPLE:

125 psi, 344^{o}F steam.

"EEV" = 1456 B.T.U./lb.

at \$ 0.70/M.B.T.U.

Dollar Value = ... \$ 1.02/1000 lbs.

$$\text{Also} = \frac{\$\ 1.02}{1000\text{ lbs.}} \times \frac{1000\text{ lbs.}}{1.164\text{ M.B.T.U.}} = \ldots\ldots \frac{\$\ 0.88}{\text{M.B.T.U.}}$$

ENERGY VALUE OF SOME FUELS

FUEL	ENERGY CONTENT	COST	RELATIVE COST
COAL	14,000 B.T.U./lb.	$ 30/ton	$ 1.07/M.B.T.U.
NO. 2 OIL	140,000 B.T.U./gal.	$ 0.30/gal.	$ 2.14/M.B.T.U.
NO. 6 OIL	150,000 B.T.U./gal.	$ 0.31/gal.	$ 2.07/M.B.T.U.
NATURAL GAS	100,000 B.T.U./therm.	$ 0.07/therm.	$ 0.70/M.B.T.U.
PROPANE	92,000 B.T.U./gal.	$ 0.33/gal.	$ 3.59/M.B.T.U.

ENERGY SURVEY AND USE ANALYSIS

1. List all utilities and fuels purchased and identify use.

EXAMPLE:

a. Electricity

Lighting
Process Machinery
Office Heating and Air Conditioning
Hot Water Heater
Refrigeration Compressor
Fans

b. Water

Drinking Fountains
Rest Rooms
Scalders
Refrigeration Condenser

c. Natural Gas

Plant Heating
Singers
Primary fuel for Boiler

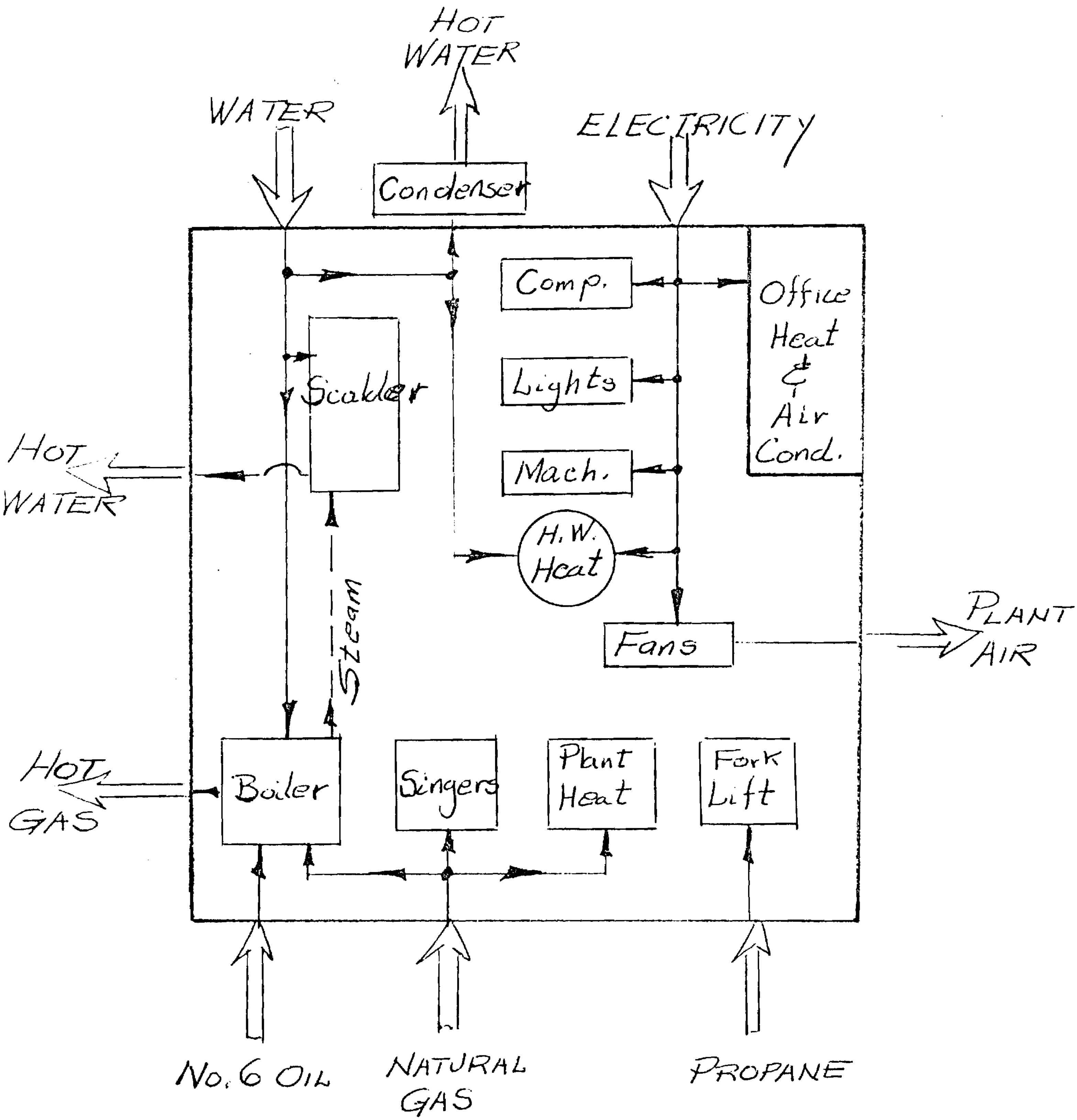
d. No. 6 Fuel Oil

Secondary Fuel for Boiler

e. Propane

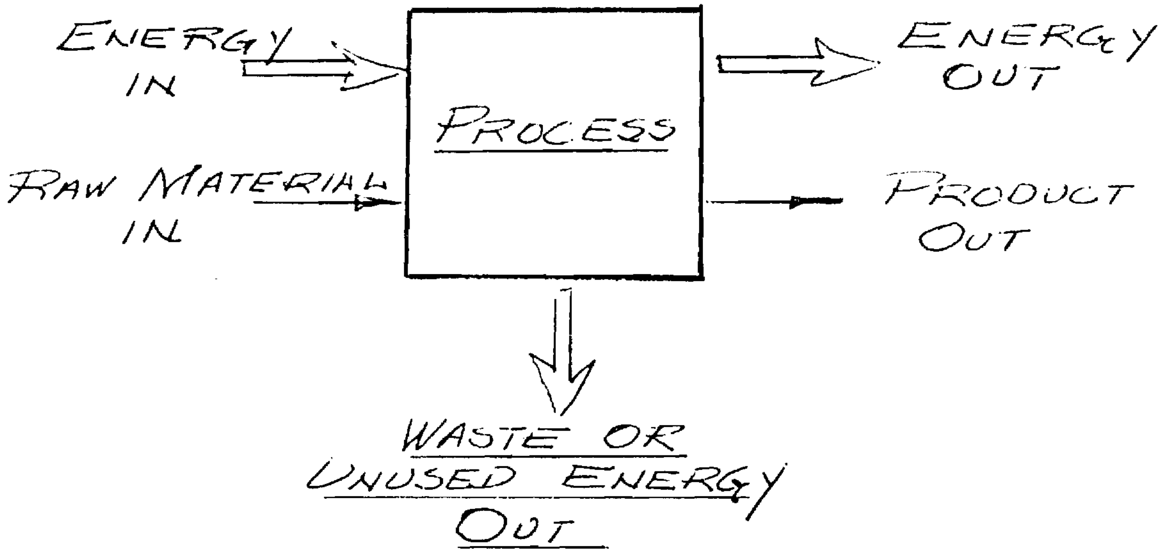
Fuel for Fork Lift

2. Construct an energy flow layout.



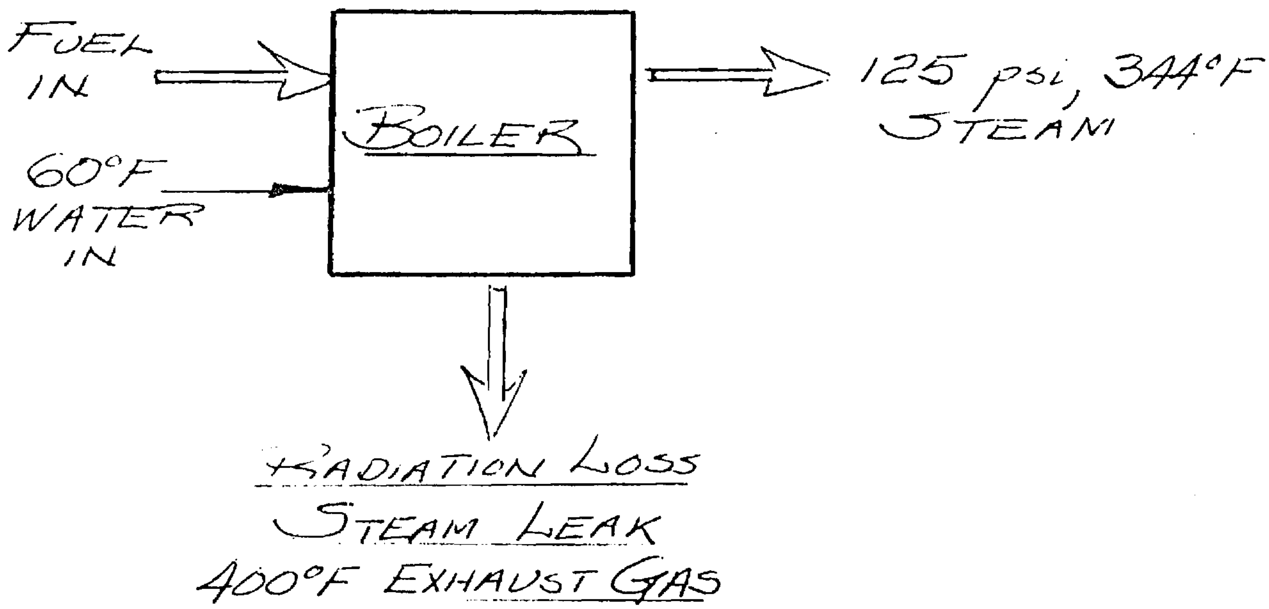
3. Continue to refine identification of energy use.

4. Take a detailed look at specific energy consuming processes to identify waste and unused energy.



EXAMPLES:

Steam Boiler



INCREASING EFFICIENCY OF ENERGY USE

1. Eliminate unnecessary use of energy.

2. Eliminate obvious losses.

3. Increase efficiency.

   Scheduling

   Equipment

4. Investigate use of unused energy.

EXAMPLES:

*1. Installation of an economizer for preheating boiler feed water.

A boiler operates an an average of 50,000 lbs./hr. of steam for 6000 hrs./year.

An economizer was installed to increase feed water temperature $60^{\circ}F$ for a

Cost = ... $ 42,000

Fuel Savings

$$= 60 \frac{BTU}{lb.} \times 50{,}000 \frac{lbs.}{hr.} \times 6000 \frac{hrs.}{yr.}$$

= 18,000 M.B.T.U./yr.

Natural Gas fired

Steam Value = $ 0.88/MBTU

Savings = (0.88)(18,000) = $ 15,840/yr.

$$\text{Payback period} = \frac{42{,}000}{15{,}840} = 2.65 \text{ years}$$

No. 6 Fuel Oil

Fuel Cost = $ 2.07/M.B.T.U.

$$\text{Steam Value} = \frac{2.07}{.8} = \$\ 2.59/\text{M.B.T.U.}$$

Savings = (2.59)(18,000) = $ 46,620/yr.

$$\text{Payback Period} = \frac{\$42{,}000}{46{,}620} = 0.9 \text{ years.}$$

* Courtesy Applied Engineering Co., Inc.

*2. A plant has a steam boiler where the value of steam is \$ 1.19/MBTU.

Unused energy from stack is 12,500 MBTU/yr.

Plant expansion planned. Heating load = 1090 MBTU/yr.

Also, to preheat feedwater 50^{o}F requires 1580 MBTU/yr.

Total heat = 2670 MBTU/yr.

* Taken from NBS Handbook 115.
Prepared by Peoples National Gas Company fro Johnson Sanitary Dairy, Johnstown, Pennsylvania.

Investigate installation of economizer.

COST

Economizer and associated equipment	=	$ 17,340
Savings from no separate heating equipment in expansion	=	$ 8,300
NET	=	$ 9,040

ANNUAL FUEL SAVINGS

Not heat expansion		$ 3,480
Feed water pre-heating	=	(1580 x 1.19)
		1,880
TOTAL		$ 5,360

$$\text{PAYBACK PERIOD} = \frac{9040}{5360} = 1.69 \text{ years}$$

*3. Recirculating Curing Oven

Size: 100 ft. long

12 ft. high

20 ft. wide

Original: 16 Burners (8 Modules)

$300,000 \text{ ft.}^3/\text{day}$

300,000,000 BTU/day

Now: 9 Burners

$150,000 \text{ ft.}^3/\text{day}$

Savings: $150,000 \text{ ft.}^3/\text{day}$

150,000,000 BTU/day

150 MBTU/day

$150 \times 250 = 37,500 \frac{\text{MBTU}}{\text{yr.}}$

Estimate gas cost at \$ 0.70/MBTU

37,500 (.70) =	\$ 26,250
Initial Cost	\$ 30,000
Payback period = $\frac{30,000}{26,250}$ =	1.14 years

* Courtesy, Coronet Industries, Dalton, Georgia.

Handout No. 2

IN-PLANT ENERGY CONSERVATION AND MANAGEMENT

Program Outline

TOP MANAGEMENT COMMITMENT

- o Inform line supervisors of:
  - The economic reason for the need to conserve energy
  - Their responsibility for implementing energy saving actions in the areas of their accountability
- o Establish a committee having the responsibility for formulating and conducting an energy conservation program and consisting of:
  - Representatives from each department in the plant
  - A Coordinator appointed by and reporting to management

    Note: In smaller organizations, the manager and his staff may conduct energy conservation activities as part of their management duties.
- o Provide the committee with guidelines as to what is expected of them:
  - Plan and participate in energy saving surveys
  - Develop uniform record keeping, reporting, and energy accounting
  - Research and develop ideas on ways to save energy
  - Communicate these ideas and suggestions
  - Suggest tough, but achievable, goals for energy saving
  - Develop ideas and plans for enlisting employee support and participation
  - Plan and conduct a continuing program of activities to stimulate interest in energy conservation efforts
- o Set goals in energy saving:
  - A preliminary goal at the start of the program
  - Later, a revised goal based on savings potential estimated from results of surveys
- o Employ external assistance in surveying the plant and making recommendations, if necessary

---

Note: This program outline was extracted from ENERGY CONSERVATION AND PROGRAM GUIDE FOR INDUSTRY AND COMMERCE (EPIC). Please refer to attached order form for additional information concerning this publication.

- o Communicate periodically to employees regarding management's emphasis on energy conservation action and report on progress

SURVEY ENERGY USES AND LOSSES

- o Conduct first survey aimed at identifying energy wastes that can be corrected by maintenance or operations actions, for example:
  - Leaks of steam and other utilities
  - Furnace burners out of adjustment
  - Repair or addition of insulation required
  - Equipment running when not needed
- o Survey to determine where additional instruments for measurement of energy flow are needed and whether there is economic justification for the cost of their installation
- o Develop an energy balance on each process to define in detail:
  - Energy input as raw materials and utilities
  - Energy consumed in waste disposal
  - Energy credit for by-products
  - Net energy charged to the main product
  - Energy dissipated or wasted

    Note: Energy equivalents will need to be developed for all raw materials, fuels, and utilities, such as electric power, steam, etc., in order that all energy can be expressed on the common basis of Btu units.
- o Analyze all process energy balances in depth:
  - Can waste heat be recovered to generate steam or to heat water or a raw material?
  - Can a process step be eliminated or modified in some way to reduce energy use?
  - Can an alternate raw material with lower energy content be used?
  - Is there a way to improve yield?
  - Is there justification for:
    - . Replacing old equipment with new equipment requiring less energy?
    - . Replacing an obsolete, inefficient process plant with a whole new and different process using less energy?
- o Conduct weekend and night surveys periodically

- o Plan surveys on specific systems and equipment, such as:
  - Steam system
  - Compressed air system
  - Electric motors
  - Natural gas lines
  - Heating and air conditioning system

IMPLEMENT ENERGY CONSERVATION ACTIONS

- o Correct energy wastes identified in the first survey by taking the necessary maintenance or operation actions
- o List all energy conservation projects evolving from energy balance analyses, surveys, etc. Evaluate and select projects for implementation:
  - Calculate annual energy savings for each project
  - Project future energy costs and calculate annual dollar savings
  - Estimate project capital or expense cost
  - Evaluate investment merit of projects using measures, such as return on investment, etc.
  - Assign priorities to projects based on investment merit
  - Select conservation projects for implementation and request capital authorization
  - Implement authorized projects
- o Review design of all capital projects, such as new plants, expansions, buildings, etc., to assure that efficient utilization of energy is incorporated in the design.

  Note: Include consideration of energy availability in new equipment and plant decisions.

DEVELOP CONTINUING ENERGY CONSERVATION EFFORTS

- o Measure results:
  - Chart energy use per unit of production by department
  - Chart energy use per unit of production for the whole plant

    Note: The procedure for calculating energy consumption per unit of product is presented in "How to Profit by Conserving Energy"
  - Monitor and analyze charts of Btu per unit of product, taking into consideration effects of complicating variables, such as outdoor ambient air temperature, level of production rate, product mix, etc.

- . Compare Btu/product unit with past performance and theoretical Btu/product unit
- . Observe the impact of energy saving actions and project implementation on decreasing the Btu/unit of product
- . Investigate, identify, and correct the cause for increases that may occur in Btu unit of product, if feasible

o Continue energy conservation committee activities

- Hold periodic meetings
- Each committee member is the communication link between the committee and the department supervisors represented
- Periodically update energy saving project lists
- Plan and participate in energy saving surveys
- Communicate energy conservation techniques
- Plan and conduct a continuing program of activities and communication to keep up interest in energy conservation
- Develop cooperation with community organizations in promoting energy conservation

o Involve employees

- Service on energy conservation committee
- Energy conservation training course
- Handbook on energy conservation
- Suggestion awards plan
- Recognition for energy saving achievements
- Technical talks on lighting, insulation, steam traps, and other subjects
- "savEnergy" posters, decals, stickers
- Publicity in plant news, bulletins
- Publicity in public news media
- Letters on conservation to homes
- Talks to local organizations

o Evaluate program

- Review progress in energy saving
- Evaluate original goals
- Consider program modifications
- Revise goals, as necessary

WHY MEASURE ENERGY

As energy is used more effectively, product costs can be reduced and profits improved. This can be accomplished even in the face of sharply increasing energy costs. Since industrial energy consumption accounts for approximately 40% of total energy used in the United States, significant contributions can be made to the national effort.

The first step to meaningful energy conservation is measurement of all the energy that enters and leaves a plant during a given period. This measurement will probably be an approximation at first but should improve with experience.

To calculate the energy content of your products, use the attached form, and then set goals for improvement. The filled in example is for ethylene; but the procedure applies equally well to any manufacturing operation, be it a grain mill pulp mill, steel mill, furniture factory, or assembly line.

Though time consuming and challenging to make the initial calculations, it will be worth the effort. Raw materials which contain, and manufacturing processes which use large amounts of energy will be pinpointed.

What To Expect — Once BTU content is determined, products can be ranked by BTU'S per unit, BTU'S per dollar of sales, and BTU'S per dollar profit. Then, as energy availability becomes more limited, it will be possible to quickly focus on the most profitable products.

Equipment associated with the large energy consuming steps will be identified. Once the energy-hogging equipment is isolated, efforts can be focused on replacing old machinery and equipment, using more energy-conscious designs, and improving maintenance programs.

Less energy-intensive raw materials should escalate less in price as energy costs increase. Having determined the energy content of raw materials, and given a choice, a better raw material selection should be possible.

Stressing the importance of BTU'S per-unit-of-production to plant operating people should provide the incentive for them to chase down where all of the input BTU'S actually end up. Often, the first attempt will account for less than 50% of the input BTU'S. Simply the act of identifying the other 50% will reveal many opportunities for improvement. For example:

1. A reduction in scrap or an improvement in yield will often be the most significant energy reduction that can be accomplished.
2. Leaking water, steam, inert gas or raw material may seem quite small as it escapes into the air, but over time this can represent a sizeable quantity of energy.
3. Heat loss from equipment can sometimes be reduced with more insulation once the losses are identified.
4. Sometimes energy lost to the environment, either through cooling water or through air, can be used advantageously to heat inlet raw materials or process equipment.
5. The energy content of waste may be recovered in part or in total by treating and recycling the waste back through the manufacturing process. In some instances, it may be possible to burn the waste and use the recovered heat in the process.
6. Temperature control equipment may be alternately heating and cooling. This problem is often corrected by a simple adjustment of the controls.
7. Recognizing that it takes 10,000 BTU'S to generate one KWH may suggest using less electricity for heating since this same KWH is capable of producing only 3,413 BTU'S of heat.
8. It may be possible to combine some manufacturing steps so that the product does not cool down between steps and subsequently have to be reheated before it is processed further.

The energy shortage is a national concern. It can also be viewed as an exciting challenge. Those companies that move quickly to meet the challenge will contribute substantially to the solution of a national problem — and make money at it.

The first step is measurement.

DEPARTMENT ____________

MONTHLY DEPARTMENT ENERGY USE

	ELECTRIC POWER			NATURAL GAS			FUEL OIL			COAL			COMPRESSED AIR		
1973	kWh	Btu/kWh	Btu	k cu ft	Btu/k cu ft	Btu	gal	Btu/gal	Btu	TONS	Btu/lb	Btu	k cu ft	Btu/k cu ft	Btu
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

DEPARTMENT ______________

MONTHLY DEPARTMENT ENERGY USE

	psig STEAM			psig STEAM			CONDENSATE USED OR LOST			WATER			TOTAL CONVERSION Btu	NUMBER OF UNITS PRODUCED	CONVERSION Btu PER UNIT OF PRODUCTION
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

DEPARTMENT ____________________

MONTHLY DEPARTMENT ENERGY USE

	RAW MATERIAL "A"			RAW MATERIAL "B"			RAW MATERIAL "C"			Total Raw Material Btu	Raw Material Btu Per Unit of Production	Total Conversion & Raw Material Btu Per Unit of Production
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												
1974												
Jan.												
Feb.												
Mar.												
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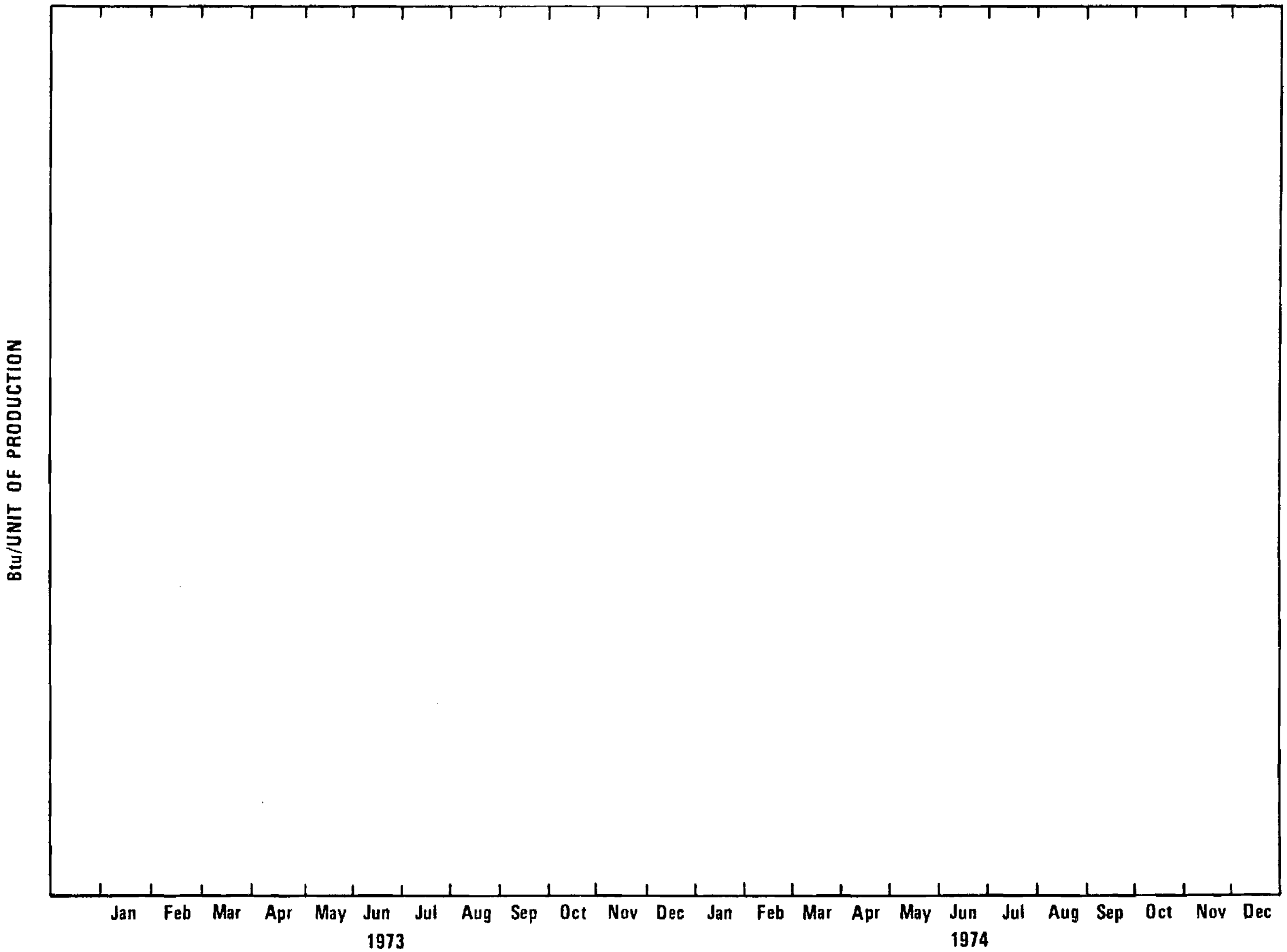
Oct.												
Nov.												
Dec.												

Tracking Chart

Energy Use Per Unit of Production

Attachment C



2.6 First Energy Saving Survey

The survey team's plan for the first survey was approved by the Energy Conservation Committee, you recall. Now we have a sequence of four letters regarding the survey. The manager endorses the survey plan. The team submits their timetable to department heads. Findings of the survey are reported. Finally, the team suggests the need for foreman training in energy conservation. Note the application of:

- Survey
- Employee involvement
- Top management commitment

2.7.3

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker, Energy Conservation Coordinator

Subject: Energy Saving Project Lists and Project Evaluation Summary

Some of our energy conservation projects will require capital; others can be done on expense. Therefore, we should have two separate lists of projects. In order to have the lists in a uniform format, the two attached forms for capital and expense projects are provided for use by all departments.

The ratio of energy savings/year per dollar invested is an indicator of how good a project is, compared to other projects. The higher the number, the better the project. In the forms, a column for percent return on investment is also included as an aid in assigning priorities on projects.

Also attached is an evaluation summary form to be used for each project.

Please submit copies of these forms to the key supervisors in your area and request that they enter their project information and return completed copies (lists and evaluations) before our next meeting one month from today.

Our manager, Mr. Parker, has requested that we continue working on the lists, revising and updating them monthly, adding new projects that evolve and additional maintenance jobs that become necessary.

cc: D. T. Parker, Plant Manager

ENERGY CONSERVATION
CAPITAL PROJECTS

Department: ____________

Date: ____________

Project Number	Project Description	Energy Savings Btu/Year	Capital Cost $	Ratio Btu/Year Saving / $ Capital	Percent ROI	Priority	Status

ENERGY CONSERVATION
EXPENSE PROJECTS

Department: ______________

Date: ______________

Project Number	Project Description	Energy Savings Btu/Year	Expense Cost $	Ratio Btu/Year Saving / $ Expense	Percent ROI	Priority	Status

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Capital ________ or Expense ________

Department ______________________________

Date ____________________

Project No. ______ Person Responsible ______________________________

Project Title: ______________________________

Description of Project: ______________________________

____

____

____

____

Location: ______________________________

Financial Evaluation

Estimated

Energy saving (electric power kWh/yr steam lb/yr etc.)

Utility or Raw Material	Saving
____________________	____________________ /yr
____________________	____________________ /yr
____________________	____________________ /yr
Total energy saving	____________________ MBtu/yr
Total energy cost saving	____________________ $/yr
Other cost saving due to:	
____________________	____________________ $/yr
Additional cost due to:	
____________________	____________________ $/yr
Net cost saving	____________________ $/yr
Cost of project	____________________ $

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Calculated

Return on investment ______________ %

Pay back period ______________ months

Other ______________ ______________

Btu/unit of production: Now ______________ After project implemented ______________

Benefits/Problems

Product quality ______________

Product yield ______________

Production rate ______________

Safety ______________

Pollution ______________

Maintenance-manpower/materials ______________

Utilities ______________

Working conditions ______________

Employee attitude ______________

Community ______________

Other benefits/problems connected with implementation:

____

____

____

Comments: ______________

____

Project rating: ______________

____

____

Planned authorization request date: ______________

2.7.4

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Energy Conservation Committee

From: T. G. Marshall, Maintenance

Subject: Communication of Ways to Save Energy

I have assembled a group of ECO's from EPIC, which are particularly applicable in our operation, along with a few good articles from the literature. I propose that we publish this as a booklet for plant wide use by supervisors. A copy of the list of ECO's chosen is attached hereto. After each of you has looked over the copy and indicated your approval, I will proceed with publication and distribution.

May I suggest that this booklet could be a useful tool in a training course as suggested in the recent letter from W. D. Smith and A. B. Jones.

cc: D. T. Parker
Plant Manager

NBS-114A (REV. 7-73)

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7. AUTHOR(S) Robert R. Gatts, Robert G. Massey, John C. Robertson			8. Performing Organ. Report No.
9. PERFORMING ORGANIZATION NAME AND ADDRESS: NATIONAL BUREAU OF STANDARDS, DEPARTMENT OF COMMERCE, WASHINGTON, D.C. 20234			10. Project/Task/Work Unit No. 4314560 11. Contract/Grant No.
12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*: Sponsored in Part by the Federal Energy Administration, Conservation and Environment, Washington, D. C. 20500			13. Type of Report & Period Covered: Final 14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

Main document designed as a handbook. Supplemental pages will be added on a periodical basis to expand and/or up-date this handbook.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The Energy Conservation Program Guide for Industry and Commerce (EPIC) is a guide to assist business and industry to establish an on-going conservation program. EPIC outlines the steps in an energy conservation program and suggests specific ways to reduce energy use in manufacturing and commercial businesses. EPIC focuses on two aspects of energy conservation:

(1) The key steps in an implementation plan for an energy conservation plan.

(2) Energy Conservation opportunities which have been identified by industry.

Library of Congress Catalog Card No. 74-600153.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Energy conservation; energy conservation guide; energy conservation opportunities; energy conservation program; industrial energy conservation.

18. AVAILABILITY	19. SECURITY CLASS (THIS REPORT)	21. NO. OF PAGES
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Handout No. 3

WE NEED YOUR HELP

On Evaluation Of The Conference

This conference on in-plant energy conservation was designed to help management of industrial concerns place into proper prospective their energy problems; to illustrate that opportunities exist for energy cost reduction; and to furnish guidance in establishment of in-plant energy conservation and management programs. In order that we may make future conferences better, we want and need your ideas, suggestions and criticisms. Please complete the following sentences.

1. Probably, the greatest single benefit I derived from this conference was ___

____

____

____

2. The subject discussed that made the biggest impression on me was ___________

____

____

____

3. I would really like to know more about ______________________

____

____

____

4. I was disappointed that you did not have more time for _______________

____

____

____

(continued on next page)

On Information About Your Specific Energy Problem

If you have an energy or energy-related raw material problem, please let us know.

1. What specific energy problems have you identified which your firm faces today?____

2. Do you feel you can adequately measure the dollar impact of rising energy costs on your products?

   _____ Yes

   _____ No. What difficulties or problems do you have in dollar measurement? __

3. What technical and management services do you have available for your energy problems? ____

On The Material To Include In The Energy Technical Workshop

A technical workshop on in-plant energy conservation is being planned for the future. This workshop will be for the individuals in your plant who will be responsible for energy conservation. Please indicate what subjects would be of interest to your personnel.

_____ Energy usage related to heating and air-conditioning.

_____ Energy usage related to boilers.

_____ Energy usage related to machinery.

_____ Lighting.

_____ Energy-intensive process (e.g., dryers).

_____ Instrumentation for energy conservation.

_____ Identification of alternatives to energy-related raw materials.

_____ Other: ____________________

On Registration For The Energy Technical Workshop And Information

Concerning In-Plant Technical Assistance

I (plan) (do not plan) to attend or send employees to the technical workshop on in-plant energy conservation. (An affirmative answer is not a commitment.)

I (would) (would not) like additional information concerning possible on-site technical assistance I can obtain from the Georgia Tech Engineering Experiment Station.

Name ______________________________

Company ____________________________

Address ____________________________

_______________ Zip Code __________

VISUAL AIDS

Visual Aid No. 1

AGENDA

WELCOME PROGRAM INTRODUCTION

ENERGY: THE CRITICAL CHOICES AHEAD

SUMMARY OF CURRENT GOVERNMENTAL POLICIES AND PROGRAMS THAT AFFECT INDUSTRIAL USE AND ASSISTANCE FURNISHED BY STATE ENERGY OFFICE

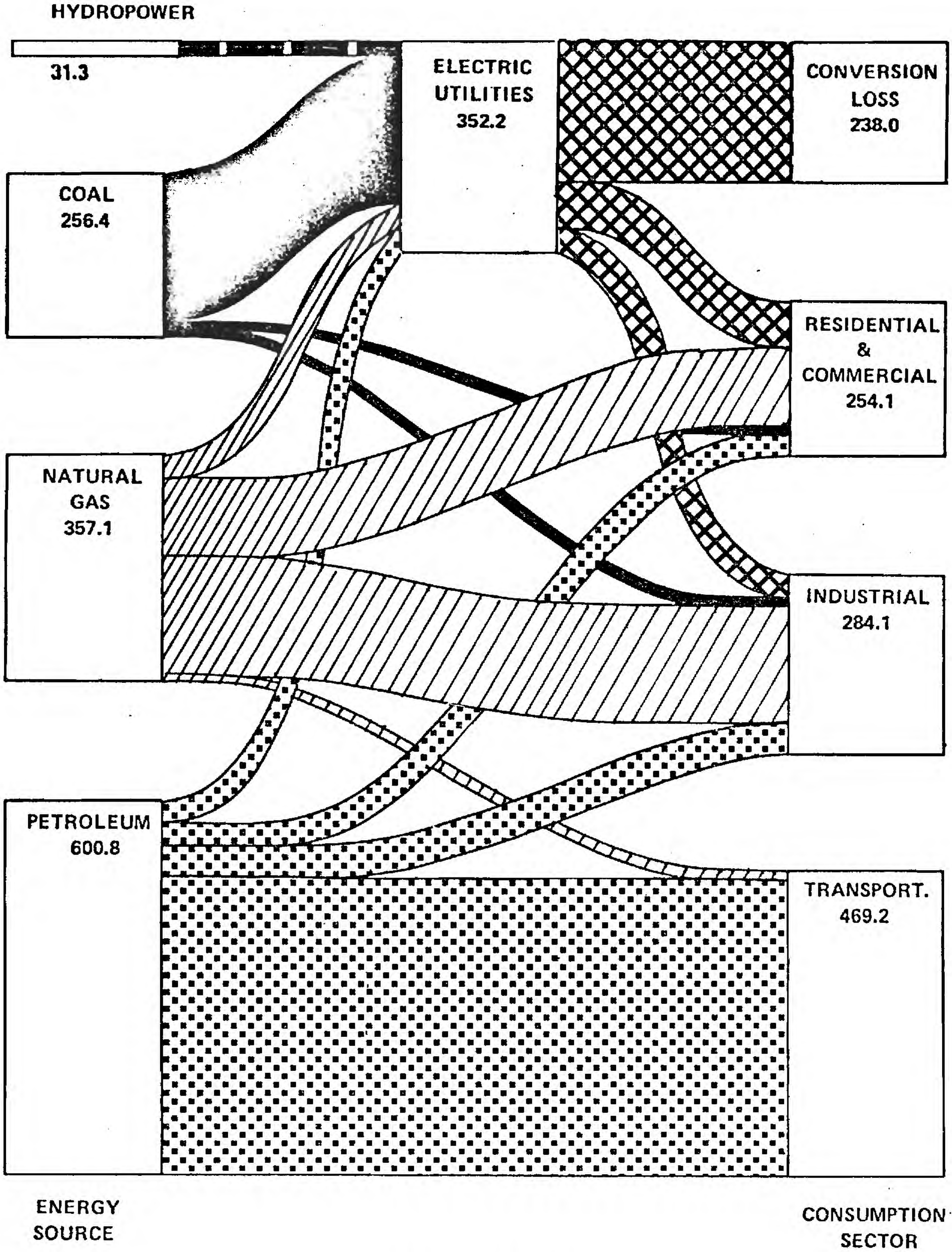
ENGINEERING APPROACHES TO ENERGY CONSERVATION

DEVELOPING AND INSTALLING THE IN-PLANT ENERGY CONSERVATION PROGRAM

ENERGY CONSERVATION OPPORTUNITIES

WHERE DO WE GO FROM HERE?
(QUESTIONS AND ANSWER SESSION)

Visual Aid No. 2

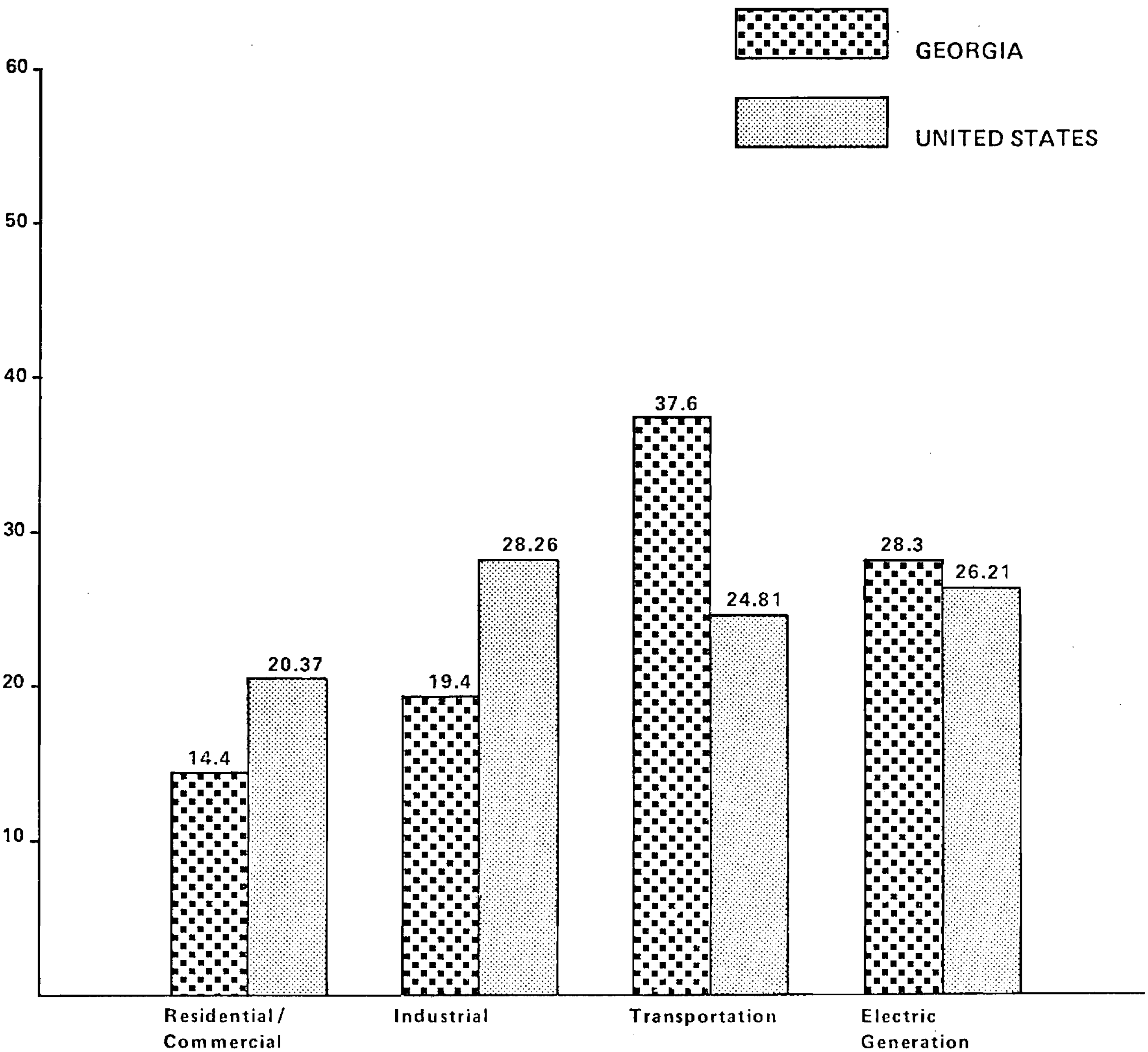


ENERGY FLOW
STATE OF GEORGIA
1973

TRILLIONS OF BTU'S

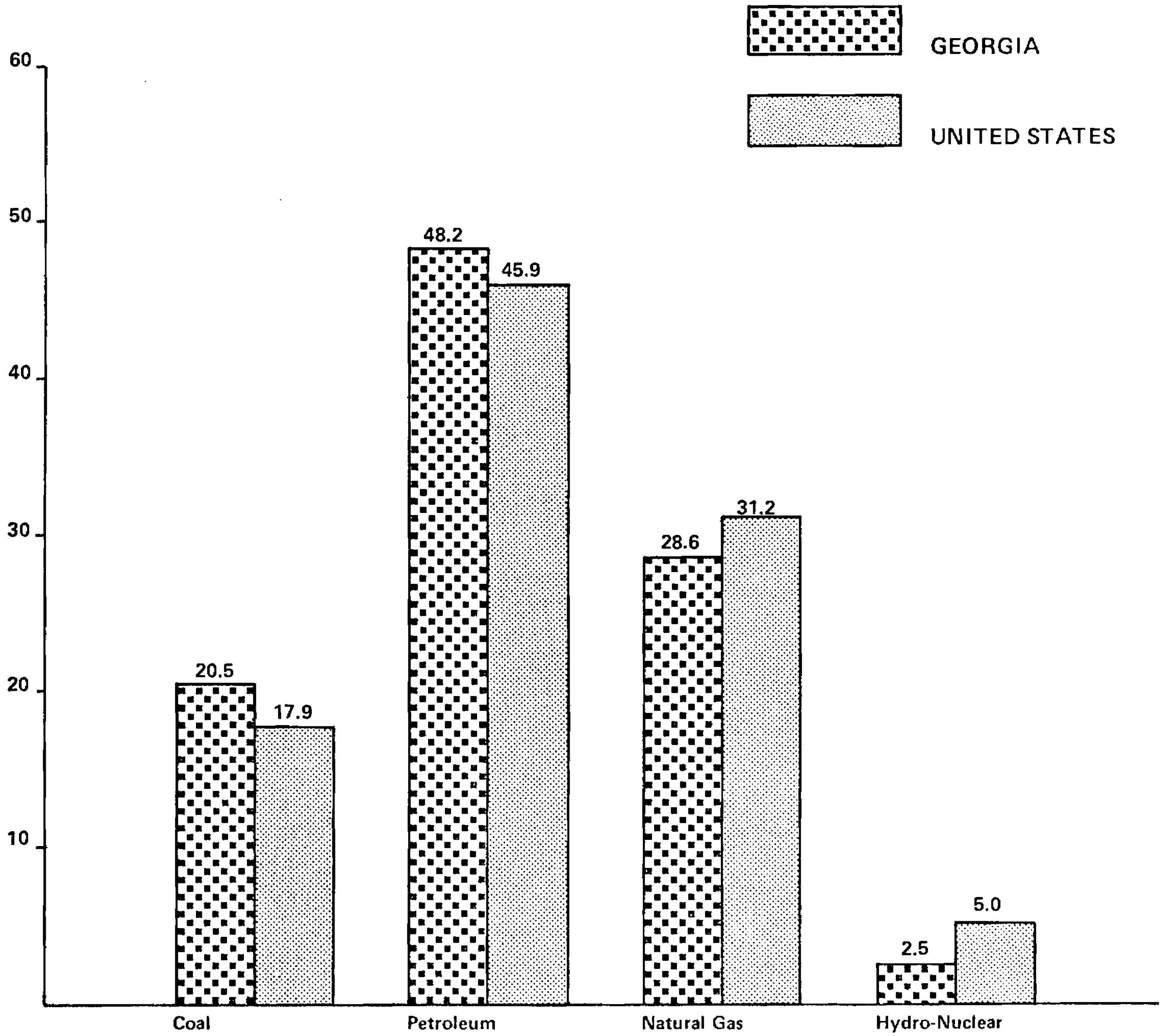
Visual Aid No. 3

COMPARISON OF % CONSUMPTION BY ECONOMIC SECTOR IN GEORGIA AND THE UNITED STATES FOR THE YEAR 1973.



Visual Aid No. 4

COMPARISON OF % CONSUMPTION OF FUEL RESOURCES BY GEORGIA AND THE UNITED STATES FOR THE YEAR 1973.



Visual Aid No. 5

PRESIDENT FORD'S ENERGY PROPOSALS

- o IMPORT FEES TOTALING $3/BBL
- o BACKUP IMPORT CONTROL PROGRAM
- o DECONTROL OF OLD OIL PRICES ON 4/1/75
- o PETROLEUM EXCISE TAX OF $2/BBL ON ALL DOMESTIC CRUDE OIL
- o DEREGULATION OF NEW NATURAL GAS
- o NATURAL GAS EXCISE TAX OF 37¢/MCF
- o AUTORIZATION OF MEASURES TO ACHIEVE DOMESTIC ENERGY PRICE LEVELS NECESSARY TO REACH SELF-SUFFICIENCY GOALS
- o STANDBY AUTHORITY TO DEAL WITH EMERGENCIES
- o INCREASE FOR ONE YEAR IN INVESTMENT TAX CREDIT TO 12%

Visual Aid No. 5

Visual Aid No. 6

SOME CONGRESSIONAL ALTERNATIVES

- PHASE IN THE DOMESTIC OIL TAX ($2/BBL) AND NATURAL GAS TAX (37¢/MCF) OVER TWO YEARS
- CONTROLS WOULD CONTINUE ON THE PRICE OF "OLD" CRUDE OIL BUT WOULD BE RAISED BY $1/BBL EACH YEAR FOR 5 YEARS BEFORE TOTAL DECONTROL WOULD BE CONSIDERED
- AN ANALOGOUS PHASED DECONTROL OF NEW NATURAL GAS PRICES
- EXISTING MANDATORY ALLOCATIONS, IMPORT QUOTAS, AND IF NECESSARY, "SIMPLIFIED" GASOLINE RATIONING
- AUTHORIZE MANDATORY ENERGY CONSERVATION
- ALLOCATION SYSTEM MIGHT BE EXTENDED TO COVER COAL AS WELL AS OIL

Visual Aid No. 7

OBJECTIVES OF THE IN-PLANT ENERGY CONSERVATION AND MANAGEMENT PROGRAM

- O INCREASE PROFITS BY SAVINGS ON ENERGY COSTS
- O PREVENT BUSINESS OR PLANT SHUTDOWN DUE TO ENERGY SHORTAGES
- O KEEP PEOPLE WORKING
- O KEEP U.S. INDUSTRY COMPETITIVE
- O KEEP U.S. INDUSTRY AS FREE FROM GOVERNMENT CONTROLS AS POSSIBLE

Visual Aid No. 8

ENERGY VALUE OF SOME FUELS

FUEL	ENERGY CONTENT	COST	RELATIVE COST
COAL	14,000 B.T.U./LB.	$30/TON	$1.07/M.B.T.U.
NO. 2 OIL	140,000 B.T.U./GAL.	$0.30/GAL.	$2.14/M.B.T.U.
NO. 6 OIL	150,000 B.T.U./GAL.	$0.31/GAL.	$2.07/M.B.T.U.
NATURAL GAS	100,000 B.T.U./THERM	$0.07/THERM.	$0.70/M.B.T.U.
PROPANE	92,000 B.T.U./GAL.	$0.33/GAL.	$3.59/M.B.T.U.

BASIC CONSIDERATIONS IN ENERGY USE

UNIT OF ENERGY IS THE B.T.U.

OUR ENERGY COMES PRIMARILY FROM FUELS: COAL, NATURAL GAS AND PETROLEUM PRODUCTS (SEE TABLE).

USES OF ENERGY ARE:

- PLANT SPACE HEATING AND AIR CONDITIONING
- PRODUCES A UTILITY: SUCH AS,
  - ELECTRICITY
  - STEAM
  - AIR
  - WATER
- DIRECT USE IN A PROCESS: SUCH AS,
  - DRYER
  - OVEN
- TRANSPORTATION

A BASIC AND USEFUL CONCEPT IS "EQUIVALENT ENERGY VALUE" WHICH IS THE TOTAL VALUE OF ENERGY IN B.T.U.'S OF ALL FUEL CONSUMED IN PRODUCING A UTILITY OR PRODUCT.

Visual Aid No. 10

ENERGY EQUIVALENT VALUE

This concept useful:

a. As an indicator of the energy intensity of a product or utility

b. As a measure of energy consumption and energy conservation

Determined by

$$\frac{\text{Total "EEV" consumed in some time period}}{\text{Number of units produced in time period}}$$

Another concept is "Energy Dollar Value" of a utility or product. It is the cost of the "EEV".

EXAMPLE:

125 psi, 344°F steam.

"EEV" = 1456 B.T.U./lb.

at \$ 0.70/M.B.T.U.

Dollar Value = ... \$ 1.02/1000 lbs.

$$\text{Also} = \frac{\$\ 1.02}{1000\ \text{lbs.}} \times \frac{1000\ \text{lbs.}}{1.164\ \text{M.B.T.U.}} = \ldots\ldots\ldots\ldots \frac{\$\ 0.88}{\text{M.B.T.U.}}$$

Visual Aid No. 11

PLEASE POST IN CONTROL ROOMS

TEN POINT CHECK LIST - ENERGY SAVINGS

1. TURN OFF UNNECESSARY LIGHTS.
2. MINIMIZE COOLING WATER FLOWS.
3. CLOSELY MONITOR PURGE GAS REQUIREMENTS.
4. MAINTAIN UTILITY METERS.
5. CHECK STEAM TRAPS. REPAIR OR REPLACE DEFECTIVE TRAPS. KEEP BY-PASS VALVES CLOSED.
6. MONITOR AND MINIMIZE REFLUX FLOWS.
7. ELIMINATE UTILITY LEAKS.
8. OPTIMIZE COMBUSTION AIR ON BOILERS AND FURNACES.
9. MINIMIZE RECYCLING IN PUMPS AND COMPRESSOR SYSTEMS.
10. MINIMIZE HEAT TRANSFER EFFICIENCIES BY KEEPING EQUIPMENT CLEAN:
    - (A) MECHANICAL OR CHEMICAL CLEANING.
    - (B) PERIODIC BACK FLUSHING.
    - (C) MAINTAIN PROPER VELOCITIES.

Visual Aid No. 12

ENERGY SURVEY AND USE ANALYSIS

LIST ALL UTILITIES AND FUELS PURCHASED AND IDENTIFY USE.

EXAMPLES:

- ELECTRICITY
  - LIGHTING
  - PROCESS MACHINERY
  - OFFICE HEATING AND AIR CONDITIONING
  - HOT WATER HEATER
  - REFRIGERATION COMPRESSOR
  - FANS
- WATER
  - DRINKING FOUNTAINS
  - REST ROOMS
  - SCALDERS
  - REFRIGERATION CONDENSER
- NATURAL GAS
  - PLANT HEATING
  - SINGERS
  - PRIMARY FUEL FOR BOILER
- NO. 6 FUEL OIL
  - SECONDARY FUEL FOR BOILER
- PROPANE
  - FUEL FOR FORK LIFT

Visual Aid No. 13

INCREASING EFFICIENCY OF ENERGY USE

o ELIMINATE UNNECESSARY USE OF ENERGY.

o ELIMINATE OBVIOUS LOSSES.

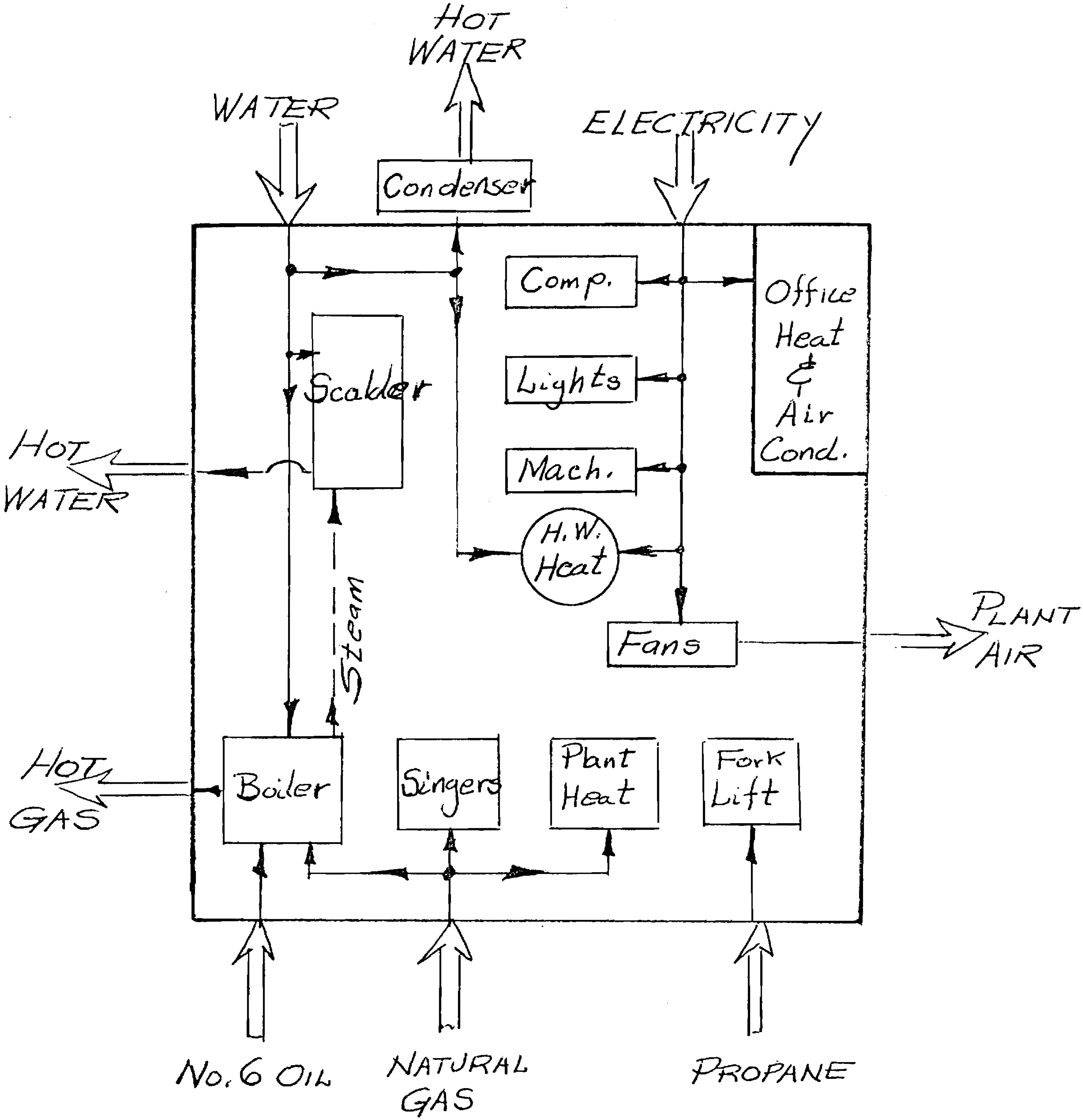
o INCREASE EFFICIENCY.

- SCHEDULING
- EQUIPMENT

o INVESTIGATE USE OF UNUSED ENERGY.

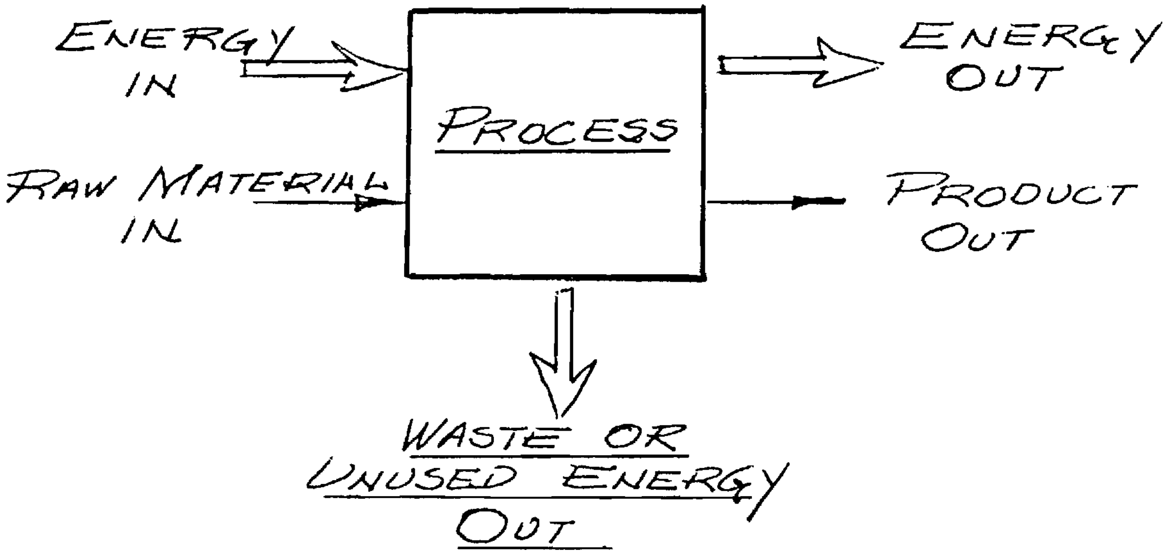
Visual Aid No. 14

ENERGY FLOW DIAGRAM



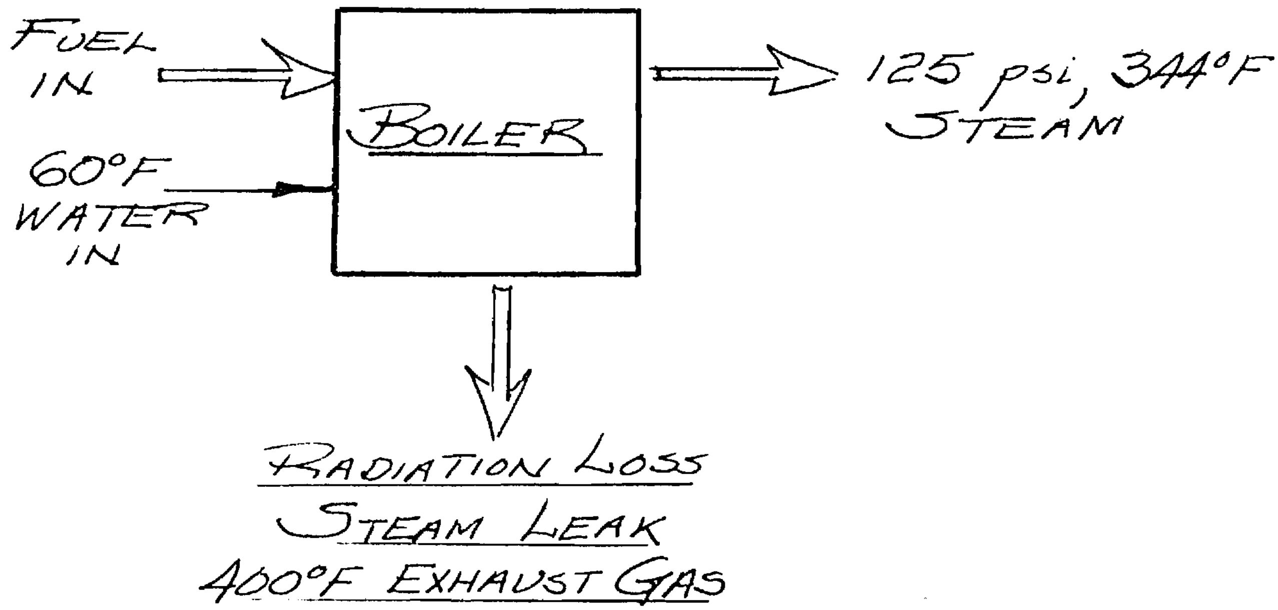
Visual Aid No. 15

ENERGY/PRCESS FLOW DIAGRAM



EXAMPLES:

Steam Boiler



INSTALLATION OF AN ECONOMIZER

FIRST EXAMPLE

50,000 LBS./HR. OF STEAM FOR 6000 HRS./YEAR.

AN ECONOMIZER WAS INSTALLED TO INCREASE FEED WATER TEMPERATURE 60^{o}F. FOR A

COST OF ECONOMIZER

$42,000

FUEL SAVINGS

$$= 60 \frac{\text{BTU}}{\text{LB.}} \times 50{,}000 \frac{\text{LBS.}}{\text{HR.}} \times 6000 \frac{\text{HRS.}}{\text{YR.}}$$

= 18,000 M.B.T.U./YR.

NATURAL GAS FIRED

STEAM VALUE = $0.88/MBTU

SAVINGS = (0.88) (18,000) = $15,840/YR.

$$\text{PAYBACK PERIOD} = \frac{42{,}000}{15{,}840} = 2.65 \text{ YEARS}$$

NO. 6 FUEL OIL

FUEL COST = $2.07/M.B.T.U.

$$\text{STEAM VALUE} = \frac{2.07}{.8} = \$2.59/\text{M.B.T.U.}$$

SAVINGS = (2.59) (18,000) = $46,620/YR.

$$\text{PAYBACK PERIOD} = \frac{\$42{,}000}{46{,}620} = 0.9 \text{ YEARS.}$$

INSTALLATION OF AN ECONOMIZER

SECOND EXAMPLE

BOILER OPERATIONS

A PLANT HAS A STEAM BOILER WHERE THE VALUE OF STEAM IS $1.19/MBTU.

UNUSED ENERGY FROM STACK IS 12,500 MBTU/YR.

PLANT EXPANSION PLANNED. HEATING LOAD = 1090 MBTU/YR.

ALSO, TO PREHEAT FEEDWATER 50^{o}F. REQUIRES 1580 MBTU/YR.

TOTAL HEAT = 2670 MBTU/YR.

COST

ECONOMIZER AND ASSOCIATED EQUIPMENT	= $17,340
SAVINGS FROM NO SEPARATE HEATING EQUIPMENT IN EXPANSION	= $ 8,300
NET	= $ 9,040

ANNUAL FUEL SAVINGS

NOT HEAT EXPANSION	$ 3,480
FEED WATER PRE-HEATING	= (1580 x 1.19)
	1,880
TOTAL	$ 5,360

PAYBACK PERIOD = $\frac{9040}{5360}$ = 1.69 YEARS

Visual Aid No. 18

CARPET CURING OVEN

SIZE: 100 FT. LONG

12 FT. HIGH

20 FT. WIDE

ORIGINAL: 16 BURNERS (8 MODULES)

300,000 FT. 3/DAY

300,000,000/BTU/DAY

NOW: 9 BURNERS

150,000 FT. 3/DAY

SAVINGS: 150,000 FT. 3/DAY

150,000,000 BTU/DAY

150 MBTU/DAY

$$150 \times 250 = 37{,}500 \ \frac{\text{MBTU}}{\text{YR.}}$$

ESTIMATE GAS COST AT $0.70/MBTU

37,500 (.70) =	$26,250
INITIAL COST	$30,000
PAYBACK PERIOD = $\frac{30,000}{26,250}$ =	1.14 YEARS

CONFERENCE HANDOUTS

Ranking of Georgia Industry by Energy Used, Natural Gas Used, and Fuel Oil Used, Employment, And Value Added by Manufacture, 1971

Industry Rank	Total Energy		Natural Gas		Fuel Oil		Employment		Value Added By Manufacture1/	
	SIC	% of Total	SIC	% of Total	SIC	% of Total	SIC	% of Total	SIC	% of Total
1	263	22.68	263	23.23	263	45.07	221	8.94	227	10.71
2	281	7.30	281	11.13	227	9.66	232	8.27	221	5.80
3	227	6.71	227	7.31	262	3.68	227	6.39	232	4.89
4	221	4.04	325	6.16	327	3.49	228	4.64	263	4.88
5	327	3.76	209	3.59	241	2.75	371	3.87	228	4.55
6	324	3.55	287	3.49	209	2.12	201	3.64	284	3.25
7	325	3.08	327	3.34	281	2.03	234	2.23	205	3.19
8	201	2.59	201	3.05	226	1.95	251	2.20	208	3.07
9	209	2.57	221	2.64	229	1.83	225	2.17	344	3.05
10	262	2.29	331	2.52	228	1.70	263	2.13	201	2.45
11	282	2.22	335	2.48	282	1.67	205	1.99	264	2.31
12	228	2.21	262	2.06	221	1.48	222	1.99	265	2.31
13	331	2.16	371	2.06	201	1.48	344	1.96	361	2.21
14	371	1.98	282	2.02	242	1.44	242	1.93	239	2.10
15	287	1.91	204	1.96	331	1.40	233	1.82	234	2.06
16	335	1.62	208	1.40	208	1.13	229	1.81	327	2.06
17	204	1.59	226	1.31	225	1.09	239	1.73	251	1.95
18	222	1.57	329	1.26	264	1.05	265	1.63	275	1.95
19	241	1.54	203	1.17	222	1.04	264	1.60	229	1.85
20	226	1.47	228	1.08	203	.94	361	1.60	242	1.76
21	229	1.36	229	1.06	371	.86	327	1.54	206	1.51
22	242	1.32	222	1.04	335	.82	231	1.53	209	1.45
23	208	1.29	205	.98	223	.78	275	1.46	325	1.14
24	264	.97	242	.86	265	.77	271	1.41	243	1.11
25	329	.92	264	.86	295	.75	208	1.41	233	1.09
26	203	.92	265	.85	325	.72	241	1.37	281	1.08
27	286	.90	344	.85	329	.64	379	1.36	204	1.07
28	205	.87	202	.84	284	.58	209	1.30	202	1.01
29	225	.87	249	.75	205	.55	243	1.20	286	.94
30	265	.86	243	.69	202	.55	335	1.06	355	.94
31	202	.82	284	.64	204	.53	203	.95	225	.92
32	344	.72	225	.59	287	.47	314	.85	352	.91
33	284	.62	295	.56	361	.38	202	.84	289	.90
34	232	.58	232	.54	344	.37	238	.81	282	.86
35	295	.58	289	.48	283	.33	355	.79	226	.86
36	243	.58	332	.44	251	.29	226	.75	283	.85

1/ Value added by manufacture is for 1972.

Sources: National Energy Data - Bureau of the Census, 1972 Census of Manufactures, Fuels and Electric Energy Consumed, July 1973. Employment Data - Bureau of the Census County Business Patterns 1971 Georgia U S

Table 2

ENERGY AUDIT SITE VISITS

IC umber	Industry	Energy Ranking	Percent GA Total Energy	Number of Firms 20-99	100-499	500-	Total	# of Visits
63	Paperboard Mills	1	22.7	1	5	8	14	1
81	Industrial Chemicals	2	7.3	20	3	1	24	2
27	Floor Covering Mills	3	6.7	73	53	15	141	8
21	Weaving Mills, Cotton	4	4.0	10	21	27	58	1
27	Concrete, Gypsum & Plaster Products	5	3.8	91	11	-	102	5
24	Cement, Hydraulic	6	3.6	1	3	-	4	1
25	Structural Clay Product	7	3.1	5	9	1	15	1
01	Meat Products	8	2.6	36	34	5	75	4
09	Misc.Foods & Kindred Products	9	2.6	31	11	1	43	1
62	Paper Mills, except Bldg. Paper	10	2.3	1	2	1	4	1
82	Plastics Materials & Synthetics	11	2.2	2	2	3	7	1
28	Yarn & Thread Mills	12	2.2	15	54	6	75	3
31	Blast Furnace & Basic Steel Products	13	2.2	4	2	1	7	1
71	Motor Vehicles & Equipment	14	2.0	12	4	7	23	2
87	Agricultural Chemicals	15	1.9	27	6	0	33	2
35	Nonferrous Rolling & Drawing	16	1.6	3	5	3	11	1
04	Grain Mill Products	17	1.6	36	4	-	40	0
22	Weaving Mills, Synthetics	18	1.6	3	11	6	20	3
41	Logging Camps & Logging Contractors	19	1.5	16	1	0	17	0
26	Textile Finishing, Except Wool	20	1.5	7	7	2	16	1
29	Misc. Textile Goods	21	1.4	11	13	4	28	0
42	Sawmills & Planing Mills	22	1.3	116	10	-	126	0
)8	Beverages	23	1.3	53	10	1	64	1
29	Misc. Nonmetallic Mineral Products	18[1/]	1.3[1/]	15	3	2	20	1
)3	Canned, Cured, & Frozen Foods	19[1/]	1.2[1/]	16	9	1	26	0
25	Knitting Mills	17[2/]	1.1[2/]	12	21	4	37	1
54	Misc. Converted Paper Products	18[2/]	1.1[2/]	16	9	3	28	0
4	Narrow Fabric Mills	[3/]		3	3	0	6	1
5	Paving & Roofing Materials	[3/]		5	2	0	6	1
3	Household Appliances	[3/]		1	2	0	3	1

[1/] Industry rank with respect to natural gas and percent of total natural gas used.

[2/] Industry rank with respect to fuel oil and percent of total fuel oil used.

[3/] Plants in these industry groups requested an energy audit site visit.

Source: Bureau of Census, County Business Patterns, Georgia. Bureau of Census, 1972 Census of Manufactures, Fuels and Electric Energy Consumed.

Table 3

SAMPLING PROCEDURE USED FOR MAIL SURVEY

In Industry Group	Total Number of Firms	Sampling Percentage	Sample Size
5-24	747	100	747
25-49	906	50	453
50-499	3,967	25	992
500 or more	1,116	10	111
Total	6,736		2,303

Table 4

Economic Sector Fuel Consumption Patterns
in Georgia, 1973
(in percent)

conomic Sector	Coal	Petroleum	Natural Gas	Hydro-Electric	All Fuels	
					%	Quantity (trillion BTUs)
esidential-Commercial	1.0	24.9	74.2	0.0	100.1	180.558
ndustrial	3.8	22.2	73.9	0.0	99.9	242.806
lectric Generation	69.5	11.6	10.0	8.9	100.0	353.010
ransportation	0.0	98.2	1.8	0.0	100.0	469.246
ll Sectors	20.6	48.2	28.7	2.5	100.0	1,245.620

Note: Percentages may not total exactly 100% due to rounding figures.

Source: McCallum, Mary, Energy Consumption in Georgia 1973, Atlanta: Georgia State Energy Office, March 1975.

Table 5

Distribution of Consumption of Fuel Resources
by Economic Sector in Georgia, 1973
(in percent)

conomic Sector	Coal	Petroleum	Natural Gas	Hydro-Electric	All Fuels
esidential-Commercial	0.7	7.5	37.5	0.0	14.5
dustrial	3.6	9.0	50.3	0.0	19.5
lectric Generation	95.7	6.8	9.9	100.0	28.3
ansportation	0.0	76.7	2.3	0.0	37.7
l Sectors					
Percent	100.0	100.0	100.0	100.0	100.0
Quantity (trillion BTUs)	256.372	600.824	357.124	31.3	1,245.620

Source: McCallum, Mary, Energy Consumption in Georgia 1973, Atlanta: Georgia State Energy Office, March 1975.

Table 6

SURVEY RESPONSE ANALYSIS

Industry	SIC Code	Number of Firms	Total Firms Surveyed	Number of Respondents	Respondents with Usable Data: Number	Respondents with Usable Data: % of Industry Employment
Food & Kindred Products	20	720	186	94	71	22.9
Textile Mill Products	22	635	193	109	89	21.5
Apparel & Other Textile Products	23	550	181	81	53	13.7
Lumber & Wood Products	24	1881	329	141	66	11.6
Furniture & Fixtures	25	207	59	30	21	8.4
Paper & Allied Products	26	151	52	28	22	22.8
Printing & Publishing	27	697	247	104	45	8.0
Chemical & Allied Products	28	315	154	97	67	30.0
Petroleum & Coal Products	29	24	16	12	11	88.8
Rubber & Plastics Products, N.E.C.	30	155	49	29	13	27.8
Leather & Leather Products	31	32	25	20	9	48.6
Stone, Clay, & Glass Products	32	423	151	87	58	33.5
Primary Metal Industries	33	62	49	34	27	53.6
Fabricated Metal Products	34	405	161	90	53	20.6
Machinery, except Electrical	35	500	172	81	49	28.1
Electrical Equipment & Supplies	36	111	123	71	26	26.0
Transportation Equipment	37	207	69	44	27	55.9
Instruments & Related Products	38	46	39	21	7	24.8
Misc. Manufacturing Industries	39	139	78	38	19	21.9
Total		7,260	2,333	1,211	733	24.4

Table 7

PLANT ENERGY CONSUMPTION RELATED TO FIRM CHARACTERISTICS BY INDUSTRY FOR RESPONDENTS, 1973
(in BTU's x 10^7)

Industry	SIC Code	Energy Use/Employee: Mean	Energy Use/Employee: Standard Deviation	Energy Use/Employee: Coefficient of Variation	Energy Use/Dollar Output: Mean	Energy Use/Dollar Output: Standard Deviation	Energy Use/Dollar Output: Coefficient of Variation	Energy Use/Firm: Mean	Energy Use/Firm: Standard Deviation	Energy Use/Firm: Coefficient of Variation
Meat Products	201	86.96	542.06	6.70	.87	19.49	22.52	13,147.14	16,954.18	1.29
Dairy Products	202	297.58	1,257.50	4.23	5.41	26.22	4.85	63,434.08	109,059.29	1.72
Canned, Cured, and Frozen Foods	203	41.14	25.14	.61	.97	.75	.77	16,868.11	10,709.64	.63
Grain Mill Products	204	1,311.33	1,292.79	.99	4.79	12.64	2.64	27,013.39	30,753.05	1.14
Bakery Products	205	273.67	927.55	3.39	6.18	38.83	6.29	83,879.82	105,617.29	1.26
Confectionery and Related Products	207	88.28	846.51	9.59	2.35	23.12	9.83	19,034.39	31,554.11	1.66
Beverages	208	365.09	3,404.69	9.33	27.92	58.26	2.09	64,195.61	173,071.07	2.70
Misc. Food and Kindred Products	209	1,039.39	2,156.67	2.07	5.90	4.90	.83	106,826.39	193,978.06	1.82
Weaving Mills, Cotton	221	36.83	23.97	.65	2.01	1.34	.67	33,061.19	35,879.04	1.09
Weaving Mills, Synthetic	222	324.34	613.10	1.89	18.19	33.17	1.82	105,735.32	238,909.17	2.26
Narrow Fabric Mills	224	24.61	20.76	.84	.13	.11	.84	1,494.93	2,424.52	1.62
Knitting Mills	225	1,277.18	2,660.20	2.08	35.55	204.56	5.75	242,200.25	681,813.37	2.82
Textile Finishing, Except Wool	226	1,903.71	66,158.46	34.75	59.85	4,702.16	78.56	557,405.16	1069,565.59	1.92
Floor Covering Mills	227	526.36	3,537.27	6.72	11.26	1,502.87	133.49	107,630.11	366,600.72	3.41
Yarn and Thread Mills	228	64.58	222.03	3.44	1.75	7.82	4.46	16,742.82	30,758.83	1.84
Misc. Textile Goods	229	254.06	3,143.62	12.37	8.23	26.75	3.25	96,861.81	225,763.72	2.33
Mens' and Boys' Suits and Coats	231	271.95	977.50	3.59	12.06	29.70	2.46	120,110.47	211,892.13	1.76
Mens' and Boys' Furnishings	232	214.90	511.77	2.38	14.15	389.26	27.52	54,333.91	86,087.18	1.58
Womens' and Misses' Outerwear	233	18.97	27.45	1.45	1.28	1.39	1.09	2,493.51	6,486.68	2.60
Womens' and Childrens' Undergarments	234	2.65	139.03	52.55	.19	19.49	101.84	529.78	679.24	1.28
Hats, Caps, and Millinery	235	.65	N/A	N/A	.04	N/A	N/A	37.75	N/A	N/A
Childrens' Outerwear	236	2.74	8.60	3.14	.24	.32	1.32	365.66	334.10	.91
Misc. Apparel and Accessories	238	40.62	79.75	1.96	.54	2.03	3.76	6,482.19	10,845.53	1.67

(continued)

Table 7 (continued)

Industry	SIC Code	Energy Use/Employee Mean	Energy Use/Employee Standard Deviation	Energy Use/Employee Coefficient of Variation	Energy Use/Dollar Output Mean	Energy Use/Dollar Output Standard Deviation	Energy Use/Dollar Output Coefficient of Variation	Energy Use/Firm Mean	Energy Use/Firm Standard Deviation	Energy Use/Firm Coefficient of Variation
Misc. Fabricated Textile Products	239	184.02	472.99	2.57	5.36	12.23	2.28	15,703.08	40,962.52	2.61
Logging Camps and Logging Contractors	241	5.70	5.21	.92	.25	9.19	36.35	39.89	28.57	.72
Sawmills and Planning Mills	242	755.78	2,605.96	3.45	21.95	100.90	4.60	37,672.58	104,427.29	2.77
Millwork, Plywood and Related Products	243	181.54	685.57	3.78	5.09	34.87	6.85	3,471.98	7,150.90	2.06
Wooden Containers	244	108.43	856.95	7.90	5.57	30.79	5.53	11,532.94	30,778.28	2.67
Misc. Wood Products	249	40.39	56.11	1.39	.78	1.13	1.45	5,024.38	6,911.38	1.38
Household Furniture	251	16,077.70	62,839.23	3.91	14.89	32.50	2.18	409,088.23	1,123,631.44	2.75
Office Furniture	252	468.92	542.95	1.16	20.45	15.40	.75	66,074.02	100,347.37	1.50
Partitions and Fixtures	254	373.97	918.09	2.45	13.90	43.46	3.13	5,329.11	11,057.82	2.07
Pulp Mills	261	7.50	N/A	N/A	.09	N/A	N/A	8,151.68	N/A	N/A
Paper Mills, Except Building Paper	262	498.30	414.97	.83	8.39	6.99	.83	240,481.86	472,021.77	1.96
Paperboard Mills	263	153.19	85.18	.56	1.64	.34	.20	50,868.21	48,133.26	.95
Misc. Converted Paper Products	264	157.51	357.74	2.27	3.79	6.79	1.79	5,618.02	8,390.43	1.49
Paperboard Containers and Boxes	265	663.24	3,671.29	5.54	14.36	82.09	5.72	46,924.57	48,465.29	1.03
Newspapers	271	69.68	108.58	1.56	4.44	6.28	1.41	1,021.99	1,949.67	1.91
Periodicals	272	21.65	16.84	.78	.74	.48	.66	996.06	1,361.97	1.37
Books	273	349.03	1,131.84	3.24	.05	N/A	N/A	9,598.28	9,517.52	.99
Misc. Publishing	274	467.77	467.77	1.00	.67	N/A	N/A	467.77	N/A	N/A
Commercial Printing	275	192.41	202.95	1.05	7.51	10.20	1.36	4,307.85	11,232.95	2.61
Manifold Business Forms	276	35.54	59.74	1.68	1.53	3.37	2.20	995.17	1,302.91	1.31
Blankbooks and Bookbindings	278	65.06	284.14	4.37	4.85	10.68	2.20	4,087.99	6,853.49	1.68
Printing Trade Services	279	2,119.04	N/A	N/A	105.95	N/A	N/A	14,833.30	N/A	N/A
Industrial Chemicals	281	216.51	1,017.36	4.70	3.43	7.85	2.29	22,784.09	59,320.61	2.60
Plastics Materials and Synthetics	282	1,263.00	9,584.30	7.59	45.57	177.60	3.90	118,581.23	158,558.11	1.34
Drugs	283	1,209.86	2,607.70	2.16	41.65	35.76	.86	54,685.68	75,833.33	1.39
Soap, Cleaners and Toilet Goods	284	838.80	3,872.90	4.62	21.88	22.84	1.04	64,707.30	82,844.93	1.28
Paints and Allied Products	285	48.34	50.53	1.05	.46	.60	1.30	3,383.48	4,896.68	1.45

(continued)

Table 7 (continued)

Industry	SIC Code	Energy Use/Employee Mean	Energy Use/Employee Standard Deviation	Energy Use/Employee Coefficient of Variation	Energy Use/Dollar Output Mean	Energy Use/Dollar Output Standard Deviation	Energy Use/Dollar Output Coefficient of Variation	Energy Use/Firm Mean	Energy Use/Firm Standard Deviation	Energy Use/Firm Coefficient of Variation
Gum and Wood Chemicals	286	130.47	75.92	.58	1.31	.83	.64	4,740.58	4,608.15	.97
Agricultural Chemicals	287	100.95	37.13	.37	.59	..14	.24	6,309.50	2,567.67	.41
Misc. Chemical Products	289	1,886.58	5,085.93	2.70	2.03	16.55	8.16	25,468.79	71,352.07	2.80
Paving and Roofing Material	295	286.13	1,446.07	5.05	4.44	76.37	17.21	41,403.71	40,274.21	.97
Tires and Inner Tubes	301	35.60	313.84	8.82	5.04	4.22	.84	21,643.17	33,421.88	1.54
Fabricated Rubber Products	306	2,434.85	5,240.31	2.15	42.40	61.35	1.45	326,270.31	504,529.38	1.55
Misc. Plastic Products	307	1,611.99	2,725.47	1.69	50.11	77.77	1.55	199,564.55	353,741.27	1.77
Footwear, Except Rubber	314	9.77	22.18	2.27	.69	1.73	2.51	2,573.38	4,118.51	1.60
Handbags and Personal Leather Goods	317	79.69	58.93	.74	4.02	2.88	.72	11,555.02	11,480.34	.99
Leather Goods, N.E.C.	319	112.66	73.25	.65	7.29	2.13	.29	3,379.70	3,086.91	.91
Glass and Glassware Pressed or Blown	322	1,637.31	2,540.56	1.55	70.82	78.36	1.11	13,917.11	10,852.04	.78
Products of Purchased Glass	323	1,395.09	1,188.39	.85	23.28	19.03	.82	117,187.85	202,635.57	1.73
Cement, Hydraulic	324	25,568.00	25,567.50	1.00	N/A	N/A	N/A	12,784.00	.04	N/A
Structural Clay Products	325	133.04	189.44	1.42	4.76	9.17	1.93	23,303.80	30,659.35	1.32
Pottery and Related Products	326	318.23	7,816.51	24.56	8.05	1,058.96	131.51	20,446.20	9,546.94	.47
Concrete, Gypsum, and Plaster Products	327	538.56	2,098.11	3.90	14.20	40.52	2.85	19,724.93	28,966.00	1.47
Cut Stone and Stone Products	328	71,810.43	117,007.71	1.63	486.34	7,381.58	15.18	861,725.21	1,534,235.25	1.78
Misc. Nonmetallic Mineral Products	329	170.52	1,624.23	9.53	5.00	57.21	11.45	37,207.37	52,947.90	1.42
Blast Furnace and Basic Steel Products	331	40.52	234.46	5.79	.92	9.83	10.74	12,585.74	11,993.51	.95
Iron and Steel Foundries	332	394.70	431.33	1.09	21.15	28.61	1.35	63,660.13	121,197.61	1.90
Drawing of Metals	335	171.02	390.64	2.28	4.09	8.10	1.98	54,896.14	45,727.08	.83
Nonferrous Foundries	336	61.43	491.74	9.01	2.80	50.59	18.09	3,144.96	2,507.42	.80
Cutlery, Hand Tools and Hardware	342	64.78	37.32	.58	1.88	1.38	.74	323.90	317.86	.98
Plumbing and Heating, Except Electric	343	862.57	6,084.87	7.05	15.00	16.62	1.11	56,067.13	94,676.68	1.69

(continued)

Table 7 (continued)

Industry	SIC Code	Energy Use/Employee Mean	Energy Use/Employee Standard Deviation	Energy Use/Employee Coefficient of Variation	Energy Use/Dollar Output Mean	Energy Use/Dollar Output Standard Deviation	Energy Use/Dollar Output Coefficient of Variation	Energy Use/Firm Mean	Energy Use/Firm Standard Deviation	Energy Use/Firm Coefficient of Variation
Fabricated Structural Metal Products	344	131.96	457.74	3.47	3.17	22.30	7.03	6,227.09	10,024.48	1.61
Metal Stampings	346	34.81	308.78	8.87	1.22	8.01	6.58	9,469.21	6,715.23	.71
Metal Services, N.E.C.	347	348.92	411.11	1.18	16.86	17.30	1.03	9,769.83	9,153.27	.94
Misc. Fabricated Wire Products	348	164.53	408.40	2.48	4.20	16.21	3.86	17,810.84	20,225.43	1.14
Misc. Fabricated Metal Products	349	32.51	33.89	1.04	2.47	2.25	.91	2,160.25	3,584.50	1.66
Farm Machinery	352	505.54	445.70	.88	9.00	24.92	2.77	117,033.39	167,472.51	1.43
Construction and Related Machinery	353	2.94	4.55	1.55	.09	3.77	40.63	207.69	165.34	.80
Metalworking Machinery	354	130.24	112.44	.86	4.49	3.53	.79	2,344.33	3,765.91	1.61
Special Industry Machinery	355	370.96	1,468.30	3.96	5.76	8.08	1.40	6,041.37	9,988.78	1.65
General Industrial Machinery	356	178.06	333.99	1.88	4.82	11.32	2.35	7,344.98	16,428.49	2.24
Office and Computing Machines	357	3.59	1.11	.31	.12	.05	.41	941.22	529.78	.56
Special Industry Machinery	358	64.23	376.77	5.87	1.88	3.60	1.92	11,548.16	7,644.29	.66
Misc. Machinery, Except Electrical	359	658.50	2,078.06	3.16	25.53	49.40	1.94	8,889.79	16,207.63	1.82
Electric Test and Distributing Equipment	361	271.89	237.44	.87	6.60	7.89	1.20	41,246.31	93,475.13	2.27
Electrical Industrial Apparatus	362	572.32	270.45	.47	27.42	11.73	.43	65,244.37	84,993.78	1.30
Household Appliances	363	106.38	137.43	1.29	13.26	N/A	N/A	30,850.96	6,987.55	.23
Electric and Wiring Equipment	364	721.57	911.09	1.26	21.53	61.19	2.84	77,568.58	72,835.42	.94
Radio and TV Receiving Equipment	365	2.96	N/A	N/A	.09	N/A	N/A	68.17	N/A	N/A
Communication Equipment	366	30.81	19.57	.64	1.28	.83	.65	15,098.12	14,648.45	.97
Electronic Components and Accessories	367	210.79	N/A	N/A	9.94	N/A	N/A	34,779.60	N/A	N/A
Misc. Electrical Equipment and Supplies	369	2,281.09	1,563.15	.69	49.48	30.14	.61	140,286.82	159,745.42	1.14
Motor Vehicles and Equipment	371	52.88	124.58	2.36	.55	2.10	3.83	55,197.36	101,981.80	1.85
Aircraft and Parts	372	2.17	6.45	2.97	.05	.47	9.25	4,767.04	6,205.00	1.30

(continued)

Table 7 (continued)

Industry	SIC Code	Energy Use/Employee Mean	Energy Use/Employee Standard Deviation	Energy Use/Employee Coefficient of Variation	Energy Use/Dollar Output Mean	Energy Use/Dollar Output Standard Deviation	Energy Use/Dollar Output Coefficient of Variation	Energy Use/Firm Mean	Energy Use/Firm Standard Deviation	Energy Use/Firm Coefficient of Variation
Ship and Boat Building and Repairing	373	5.96	3.38	.57	.33	.17	.50	1,260.96	1,251.47	.99
Misc. Transportation Equipment	379	1,348.33	2,065.18	1.53	26.05	72.58	2.79	99,270.74	201,842.53	2.03
Mechanical Measuring, Control Devices	382	5.02	2.32	.46	.23	.09	.37	1,169.86	1,018.76	.87
Medical Instruments and Supplies	384	37.85	16.60	.44	.48	.58	1.22	2,586.45	3,420.49	1.32
Watches, Clocks, and Watchcases	387	251.09	183.09	.73	.22	N/A	N/A	17,827.45	17,798.04	1.00
Toys and Sporting Goods	394	271.56	215.68	.79	20.58	15.49	.75	17,424.92	33,348.65	1.91
Pens, Pencils, Office and Art Supplies	395	1,932.62	5,974.19	3.09	48.35	252.26	5.22	98,011.36	213,066.16	2.17
Costume Jewelry and Notions	396	5.70	N/A	N/A	.17	N/A	N/A	2,503.34	N/A	N/A
Misc. Manufactures	399	62.12	241.86	3.89	3.23	10.13	3.14	3,789.59	4,649.59	1.23

Table 8

PLANT ENERGY CONSUMPTION BY FUNCTIONAL USE, ENERGY TYPE, AND INDUSTRY, 1973

Industry	SIC Code	Respondents: No.	Respondents: % Industry Employment	Energy Used (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Respondents Percent Energy Use: Fuel Oil	Respondents Percent Energy Use: Natural Gas	Respondents Percent Energy Use: Coal	Respondents Percent Energy Use: LP Gas	Respondents Percent Energy Use: Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Food and Kindred Products	20	70	22.8	3,578,245	25	70	5	22	4	71	*	3	*	16,736,000
Textile Mill Products	22	84	21.1	10,478,675	32	67	1	38	4	55	*	3	*	47,866,000
Apparel and Other Textile Products	23	50	13.6	15,454,151	54	46	*	50	2	45	*	3	0	11,683,275
Lumber and Wood Products	24	46	10.4	697,399	48	50	2	30	19	37	0	14	*	9,100,000
Furniture and Fixtures	25	21	8.4	3,991,243	47	48	5	14	0	80	0	6	*	14,771,000
Paper and Allied Products	26	21	22.8	1,737,284	16	82	2	24	35	38	*	3	*	9,265,400
Printing and Publishing	27	41	7.8	156,781	59	39	2	28	*	59	0	13	0	7,452,200
Chemicals and Allied Products	28	66	30.0	2,939,104	32	67	1	22	10	67	*	1	*	10,003,700
Petroleum and Coal Products	29	10	97.5	414,037	19	79	2	8	7	80	0	5	0	424,000
Rubber and Plastics Products	30	12	50.6	2,389,475	39	59	2	22	0	78	0	*	0	15,851,000
Leather and Leather Products	31	11	48.6	48,689	68	32	0	28	3	68	0	1	0	74,700
Stone, Clay, and Glass Products	32	53	33.4	8,544,173	36	62	2	18	8	72	*	2	0	19,961,500
Primary Metal Industries	33	27	53.6	988,614	23	76	1	13	3	79	0	5	0	1,994,100
Fabricated Metal Products	34	53	20.6	562,128	30	68	2	23	3	65	*	9	0	2,519,300
Machinery, Except Electrical	35	47	21.4	962,185	47	53	*	38	1	55	0	6	0	4,694,700

*Figure was less than 1%

Table 8 (continued)

Industry	SIC Code	Respondents: No.	Respondents: % Industry Employment	Energy Uses (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Fuel Oil	Natural Gas	Coal	LP Gas	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Electrical Equipment and Supplies	36	25	26.0	1,568,528	45	55	0	15	*	84	0	1	*	9,797,500
Transportation Equipment	37	25	55.8	1,372,497	37	63	*	35	23	40	*	2	0	13,384,100
Instruments and Related Products	38	7	24.8	45,754	49	51	0	34	*	57	0	9	0	316,200
Miscellaneous Manufacturing Industries	39	19	21.9	812,080	43	56	1	19	2	78	*	1	0	3,255,000
Total		688	24.0	56,741,042	39	59	2	25	7	62	1	5	*	199,149,675

Table 8

PLANT ENERGY CONSUMPTION BY FUNCTIONAL USE, ENERGY TYPE, AND INDUSTRY 1973

Industry	SIC Code	Respondents: No.	Respondents: % Industry Employment	Respondents: Energy Used (10^7 BTU's)	Percent Functional Use: Space Heating and Aid Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Respondents Percent Energy Use: Fuel Oil	Respondents Percent Energy Use: Natural Gas	Respondents Percent Energy Use: Coal	Respondents Percent Energy Use: LP Gas	Respondents Percent Energy Use: Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Meat Products	201	13	13.3	170,913	28	63	9	32	8	51	*	9	*	1,285,000
Dairy Products	202	6	26.3	380,604	17	83	*	23	9	68	0	0	0	1,447,000
Canned, Cured, and Frozen Products	203	2	15.3	33,736	15	78	7	10	0	88	0	2	0	220,000
Grain Mill Products	204	10	7.5	270,134	28	72	0	26	6	60	0	7	1	3,602,000
Bakery Products	205	10	35.4	838,798	27	73	0	8	*	91	0	*	0	2,369,000
Confectionery and Related Products	207	8	58.2	152,275	24	62	14	20	4	74	0	2	0	262,000
Beverages	208	12	26.1	770,347	27	72	1	33	6	60	1	0	0	2,951,000
Misc. Foods and Kindred Products	209	9	20.9	961,438	34	60	6	24	2	74	*	0	0	4,600,000
Weaving Mills, Cotton	221	9	24.2	297,551	18	82	0	44	6	49	*	1	0	1,299,000
Weaving Mills, Synthetic	222	10	61.0	1,057,353	31	69	*	38	6	56	0	0	0	1,733,000
Narrow Fabric Mills	224	4	38.2	5,980	34	66	0	83	1	16	0	0	0	15,000
Knitting Mills	225	11	22.2	2,664,203	44	52	4	11	2	87	0	*	0	12,000,000
Textile Finishing, Except Wool	226	5	25.8	2,787,026	11	89	0	34	4	62	0	0	*	10,802,000
Floor Covering Mills	227	25	15.0	2,690,753	28	71	1	18	9	63	0	10	0	17,938,000
Yarn and Thread Mills	228	12	13.2	200,914	46	51	3	48	2	47	0	3	0	1,522,000
Misc. Textile Goods	229	8	30.3	774,895	45	55	0	26	*	65	*	8	0	2,557,000
Men's and Boy's Suits and Coats	231	6	43.0	720,663	42	58	0	18	0	82	*	0	0	1,676,000
Men's and Boy's Furnishings	232	12	8.3	652,007	40	59	1	24	1	74	0	1	0	7,856,000
Women's and Misses' Outerwear	233	8	11.9	22,442	57	43	0	62	13	23	0	2	0	188,000
Women's and Children's Undergarments	234	3	7.3	2,119	67	33	0	75	0	25	0	0	0	29,000

*Denotes less than 1%

Table 8

Industry	SIC	Respondents: No.	Respondents: % Industry Employment	Respondents: Energy Uses (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Respondents Percent Energy Use: Fuel Oil	Respondents Percent Energy Use: Natural Gas	Respondents Percent Energy Use: Coal	Respondents Percent Energy Use: LP Gas	Respondents Percent Energy Use: Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Hats, Caps, and Millinery	235	1	50.4	38	67	33	0	98	0	2	0	0	0	75
Children's Outerwear	236	7	54.5	2,560	64	36	0	36	2	35	0	27	0	4,700
Misc. Apparel and Accessories	238	5	34.3	32,411	46	54	0	54	0	46	0	0	0	94,500
Misc. Fabricated Textile Products	239	8	7.7	141,328	53	47	*	31	0	69	0	0	0	1,835,000
Logging Camps and Logging Contractors	241	3	0.4	120	76	24	0	18	32	0	0	50	0	30,000
Sawmills and Planning Mills	242	12	6.7	489,743	18	82	0	43	21	30	0	6	*	7,309,000
Millwork, Plywood and Related Products	243	15	3.8	55,552	56	42	2	18	18	54	0	10	0	1,462,000
Wooden Containers	244	11	61.8	126,862	23	75	2	45	10	43	0	2	*	205,000
Misc. Wood Products	249	5	26.7	25,122	65	35	*	25	13	58	0	4	*	94,000
Household Furniture	251	9	26.0	3,681,794	49	45	6	16	0	65	0	19	0	14,160,000
Office Furniture	252	4	100.0	266,816	32	60	8	4	0	96	0	*	0	267,000
Partitions and Fixtures	254	8	12.4	42,633	60	40	0	23	0	77	0	0	*	344,000
Pulp Mills	261	1	44.5	8,152	7	93	*	0	86	0	0	14	*	20,400
Paper Mills, Except Building Paper	262	4	40.7	1,202,409	2	98	0	70	25	5	*	*	*	2,954,000
Paperboard Mills	263	6	43.0	305,317	2	98	0	25	61	14	0	*	0	745,000
Misc. Converted Paper Products	264	6	4.6	33,708	35	65	*	23	*	77	0	*	0	733,000
Paperboard Containers and Boxes	265	4	3.9	187,698	36	56	8	4	3	92	0	1	0	4,813,000
Newspapers	271	6	1.4	6,132	66	34	0	48	0	52	0	*	0	438,000
Periodicals	272	2	23.4	2,988	50	50	0	56	0	44	0	0	0	12,800

*Denotes less than 1%

Table 8 (continued)

Industry	SIC Code	Respondents			Percent Functional Use			Respondents Percent Energy Use						Estimated Total Industrial Energy Consumption (10^7 BTU's)
		No.	% Industry Employment	Energy Uses (10^7 BTU's)	Space Heating and Air Conditioning	Processing/Production	Other	Electricity	Fuel Oil	Natural Gas	Coal	LP Gas	Other	
Books	273	2	12.2	19,196	60	40	0	23	0	0	0	77	0	157,000
Misc. Publishing	274	1	N/A	4,597	97	3	0	9	0	91	0	0	0	N/A
Commercial Printing	275	16	6.4	77,541	52	48	*	17	0	79	0	4	0	1,212,000
Manifold Business Forms	276	7	40.1	6,966	58	39	3	46	0	54	0	0	0	17,400
Blankbooks and Book Bindings	278	6	19.2	24,528	56	44	*	17	0	58	0	25	0	128,000
Printing Trade Services	279	1	2.2	14,833	35	65	0	0	0	100	0	0	0	674,000
Industrial Chemicals	281	17	56.8	387,329	30	70	0	30	18	47	0	5	0	695,000
Plastics Materials and Synthetics	282	9	38.2	1,067,231	35	55	10	22	11	67	*	*	0	2,800,000
Drugs	283	5	17.7	273,429	42	58	0	25	2	73	0	0	0	1,545,000
Soap, Cleaners and Toilet Goods	284	14	32.9	905,902	33	67	0	18	*	82	0	0	0	2,753,000
Paints and Allied Products	285	7	24.5	23,684	40	60	0	24	0	76	0	0	0	96,700
Gum and Wood Chemicals	286	2	9.0	14,222	23	77	0	28	38	27	0	7	*	158,000
Agricultural Chemicals	287	2	6.3	12,619	1	99	0	16	14	70	0	0	0	200,000
Misc. Chemical Products	289	10	14.5	254,688	51	49	0	16	0	84	0	*	0	1,756,000
Paving and Roofing Materials	295	10	97.5	414,037	19	79	2	8	7	80	0	5	0	424,000
Tires and Inner Tubes	301	3	18.8	86,572	22	78	0	44	0	56	0	*	0	514,000
Fabricated Rubber Products	306	4	21.4	1,305,080	21	79	0	7	0	91	0	2	0	6,098,000
Misc. Plastics Products	307	5	10.8	997,823	48	45	7	14	0	86	0	*	0	9,239,000
Footwear, except Rubber	314	6	47.7	15,440	74	26	0	30	8	60	0	2	0	32,400
Handbags and Personal Leather Goods	317	2	91.1	23,110	80	20	0	51	0	49	0	0	0	25,400

*Denotes less than 1%

Table 8 (continued)

Industry	SIC Code	Respondents No.	Respondents % Industry Employment	Energy Used (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Fuel Oil	Natural Gas	Coal	LP Gas	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Leather Goods, N.E.C.	319	3	60.0	10,139	50	50	0	4	0	96	0	0	0	16,900
Glass and Glassware Pressed or Blown	322	2	1.0	27,834	37	63	0	1	0	99	0	0	0	2,783,000
Products of Purchased Glass	323	4	42.3	468,751	62	38	0	30	0	70	0	0	0	1,108,000
Cement, Hydraulic	324	1	36.9	104,682	66	34	0	6	0	94	*	0	0	284,000
Structural Clay Products	325	12	62.0	279,646	25	75	0	28	17	53	0	2	0	451,000
Pottery and Related Products	326	4	86.2	81,785	10	79	11	4	*	95	0	*	0	94,900
Concrete, Gypsum, and Plaster Products	327	14	8.3	315,599	29	70	1	15	18	58	0	9	0	3,802,000
Cut Stone and Stone Products	328	8	6.0	6,893,802	47	53	0	37	15	48	*	0	0	11,490,000
Misc. Nonmetallic Mineral Products	329	8	93.1	372,074	15	80	5	26	14	60	0	*	0	399,600
Blast Furnace and Basic Steel Products	331	7	94.6	88,100	27	73	0	9	10	77	0	4	0	93,100
Iron and Steel Foundries	332	7	60.0	445,620	24	76	0	18	1	80	0	1	0	742,700
Nonferrous Rolling and Drawing of Metals	335	8	38.5	439,169	11	86	3	11	2	86	0	1	0	1,140,000
Nonferrous Foundries	336	5	86.0	15,725	29	71	0	12	*	74	0	14	0	18,300
Cutlery, Hand Tools and Hardware	342	3	4.9	972	62	26	12	12	0	65	0	23	0	19,800
Plumbing and Heating, Except Electric	343	4	49.1	224,268	25	75	0	26	10	40	0	24	0	456,700
Fabricated Structural Metal Products	344	21	8.4	130,769	42	58	0	25	5	66	0	4	0	1,557,000
Metal Stampings	346	6	42.1	56,815	35	55	10	20	1	74	0	5	0	135,000

*Denotes less than 1%

Table 8 (continued)

Industry	SIC Code	Respondents No.	Respondents % Industry Employment	Energy Used (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Fuel Oil	Natural Gas	Coal	LP Gas	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Metal Services, N.E.C.	347	6	30.0	58,619	32	68	0	28	3	59	0	10	0	195,000
Misc. Fabricated Wire Products	348	4	54.0	71,243	25	75	0	14	0	86	0	*	0	132,000
Misc. Fabricated Metal Products	349	9	81.6	19,442	47	53	*	33	0	67	*	*	0	23,800
Farm Machinery	352	6	45.6	702,200	36	64	0	9	0	81	0	10	0	1,540,000
Construction and Related Machinery	353	5	15.3	1,038	55	45	*	70	0	20	0	10	0	6,800
Metalworking Machinery	354	4	8.1	9,377	40	60	0	49	0	49	0	2	0	115,700
Special Industry Machinery	355	7	2.9	42,289	58	42	0	8	0	79	0	13	0	1,458,000
General Industrial Machinery	356	8	96.0	58,760	46	48	6	27	0	65	0	8	0	61,200
Office and Computing Machines	357	2	57.1	1,882	63	37	0	63	0	37	0	0	0	3,300
Service Industry Machines	358	5	31.6	57,741	40	60	0	22	0	76	0	2	0	182,700
Misc. Machinery, Except Electrical	359	10	6.7	88,898	40	60	0	26	8	66	0	0	0	1,327,000
Electric Test and Distributing Equip.	361	9	23.8	412,463	44	56	0	14	0	86	0	*	0	1,733,000
Electrical Industrial Apparatus	362	3	24.3	195,733	45	55	0	*	0	99	0	*	0	805,000
Household Appliances	363	1	20.9	23,867	29	71	0	9	*	85	0	6	0	114,000
Electric and Wiring Equipment	364	4	16.0	310,274	49	51	0	2	0	98	0	*	0	1,939,000
Radio and TV Receiving Equipment	365	1	76.6	68	100	0	0	42	0	58	0	0	0	90

*Denotes less than 1%

Table 8 (continued)

Industry	SIC Code	Respondents: No.	Respondents: % Industry Employment	Energy Used (10^7 BTU's)	Percent Functional Use: Space Heating and Air Conditioning	Percent Functional Use: Processing/Production	Percent Functional Use: Other	Respondents Percent Energy Use: Electricity	Fuel Oil	Natural Gas	Coal	LP Gas	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Communication Equip.	366	2	87.8	30,196	20	80	0	50	0	50	0	0	0	34,400
Electronic Components and Accessories	367	1	48.9	34,780	50	50	0	1	0	99	0	0	0	71,000
Misc. Electrical Equip and Supplies	369	4	11.0	561,147	21	79	0	1	0	99	0	0	*	5,101,000
Motor Vehicles and Equipment	371	10	58.4	551,974	38	62	0	19	*	77	0	4	0	945,000
Aircraft and Parts	372	5	93.0	23,835	30	69	1	33	37	30	0	0	0	25,600
Ship and Boat Building and Repairing	373	2	55.5	2,522	26	73	1	44	56	0	*	*	0	4,500
Misc. Transportation Equipment	379	8	6.4	794,166	52	48	0	45	0	52	0	3	0	12,409,000
Mechanical Measuring, Control Devices	382	2	74.9	2,340	37	63	0	40	*	60	0	*	0	3,100
Medical Instruments and Supplies	384	3	17.2	7,759	68	32	0	25	*	63	0	12	0	45,100
Watches, Clocks and Watchcases	387	2	13.3	35,655	41	59	0	38	0	47	0	15	0	268,000
Toys and Sporting Goods	394	6	21.5	104,550	49	51	0	35	0	65	0	0	0	486,000
Pens, Pencils, Office and Art Supplies	395	7	25.7	686,079	45	55	*	13	0	87	0	0	0	2,670,000
Costume Jewelry and Notions	396	1	20.0	2,503	13	87	0	*	9	91	0	0	0	12,500
Misc. Manufacturers	399	5	21.9	18,948	64	30	6	26	0	71	*	3	0	86,500
Total		688	24.0	56,741,042	39	59	2	25	7	62	1	5	*	199,149,675

Table 9

TRANSPORTATION ENERGY CONSUMPTION BY FUNCTIONAL USE AND INDUSTRY, 1973

Industry	SIC Code	Respondents Number	Respondents % Industry Employment	Respondents Energy Used (10^7 BTU's)	Respondents Percent Fuel Type Gas	Respondents Percent Fuel Type Diesel	Respondents Percent Fuel Type Other	Respondents Percent Functional Use On-Road Use	Respondents Percent Functional Use Off-Road Use	Respondents Percent Functional Use Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Food and Kindred Products	20	42	14.7	92,470	64	36	0	93	7	*	735,200
Textile Mill Products	22	65	17.9	16,845	90	10	*	90	10	*	135,400
Apparel and Other Textile Products	23	38	10.4	3,969	99	1	0	96	1	3	49,000
Lumber and Wood Products	24	42	8.8	24,281	62	38	0	70	30	*	1,017,200
Furniture and Fixtures	25	18	7.8	2,214	91	8	0	81	19	*	63,900
Paper and Allied Products	26	18	20.5	15,854	50	50	*	48	52	0	198,000
Printing and Publishing	27	34	7.2	2,811	100	0	0	93	7	0	52,800
Chemicals and Allied Products	28	49	26.0	9,997	90	10	*	63	37	*	32,850
Petroleum and Coal Products	29	9	98.1	9,928	61	39	0	51	49	0	10,100
Rubber and Plastics Products	30	12	27.7	7,752	63	37	0	90	10	0	16,400
Leather and Leather Products	31	7	32.5	617	100	0	0	96	4	0	1,900
Stone, Clay, and Glass Products	32	50	32.5	41,709	66	34	0	74	24	2	178,610
Primary Metal Industries	33	21	49.1	20,685	82	18	0	60	40	0	49,550
Fabricated Metal Products	34	46	19.6	10,527	87	13	0	79	21	*	71,960
Machinery, Except Electrical	35	37	17.5	12,721	89	11	0	84	16	*	64,530
Electrical Equipment and Supplies	36	24	24.2	3,394	94	6	*	73	18	9	19,480
Transportation Equipment	37	21	51.3	23,959	82	18	0	75	25	*	91,650
Instruments and Related Products	38	7	24.8	745	99	1	0	94	6	0	3,450
Miscellaneous Manufacturing Industries	39	15	20.9	3,112	75	25	0	91	8	1	14,150
Total		555	20.3	303,590	81	19	*	79	20	1	2,806,130

* Exact fuel type unknown, but cost exceeds 10% of total energy cost

Table 9

TRANSPORTATION ENERGY CONSUMPTION BY FUNCTIONAL USE AND INDUSTRY, 1973

Industry	SIC Code	Respondents Number	Respondents % Industry Employment	Respondents Energy Used (10^7 BTU's)	Respondents Percent Fuel Type Gas	Diesel	Other	Respondents Percent Functional Use On-Road Use	Off-Road Use	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Meat Products	201	10	10.5	14,894	81	19	0	76	13	1	141,800
Dairy Products	202	5	25.8	24,545	84	16	0	99	1	0	95,100
Canned, Cured, and Frozen Foods	203	1	7.4	1,224	81	19	0	90	10	0	16,400
Grain Mill Products	204	5	4.3	10,651	33	67	0	94	6	0	247,700
Bakery Products.	205	8	23.2	27,805	43	57	0	98	1	1	119,800
Confectionery and Related Products	207	4	35.8	4,694	44	66	0	96	4	0	13,100
Beverages	208	9	7.8	7,200	89	11	0	93	7	0	92,300
Misc. Foods and Kindred Products	209	5	16.1	1,457	98	2	0	96	4	0	9,000
Weaving Mills, Cotton	221	9	24.2	1,469	93	7	*	53	46	1	6,000
Weaving Mills, Synthetic	222	8	56.6	1,730	89	11	*	80	14	6	3,000
Narrow Fabric Mills	224	1	1.6	48	100	0	0	100	0	0	3,000
Knitting Mills	225	9	9.3	875	89	11	0	99	1	0	9,400
Textile Finishing, Except Wool	226	3	11.8	193	100	0	0	81	19	0	1,600
Floor Covering Mills	227	20	10.9	11,124	80	20	0	78	22	0	102,000
Yarn and Thread Mills	228	8	10.4	921	81	19	*	87	13	0	8,800
Misc. Textile Goods	229	7	30.0	485	90	10	*	56	44	0	1,600
Men's and Boys' Suits and Coats	231	5	22.4	550	90	10	0	100	0	0	2,400
Men's and Boys' Furnishings	232	8	6.6	2,313	100	0	0	100	0	0	35,000
Women's and Misses' Outerwear	233	6	7.8	224	100	0	0	77	0	23	2,800
Women's and Children's Undergarments	234	2	6.3	28	100	0	0	100	0	0	400

*Exact fuel type unknown, but cost exceeds 10% of total transportation energy cost.

Table 9 (continued)

Industry	Code	Respondents: Number	Respondents: % Industry Employment	Respondents: Energy Used (10^7 BTU's)	Respondents Percent Fuel Type: Gas	Respondents Percent Fuel Type: Diesel	Respondents Percent Fuel Type: Other	Respondents Percent Functional Use: On-Road Use	Respondents Percent Functional Use: Off-Road Use	Respondents Percent Functional Use: Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Hats, Caps, and Millinery	235	1	50.4	21	100	0	0	100	0	0	40
Children's Outerwear	236	5	39.8	191	100	0	0	100	0	0	480
Misc. Apparel and Accessories	238	3	27.0	48	100	0	0	100	0	0	180
Misc. Fabricated Textile Products	239	8	7.7	594	100	0	0	90	10	0	7,700
Logging Camps and Logging Contractors	241	3	0.4	3,215	52	48	0	89	11	*	803,700
Sawmills and Planning Mills	242	12	6.1	6,835	52	48	0	61	39	0	112,000
Millwork, Plywood and Related Products	243	14	3.2	1,863	93	7	0	87	11	2	58,200
Wooden Containers	244	9	45.4	2,912	64	36	0	51	49	0	6,400
Misc. Wood Products	249	5	25.6	9,456	51	49	0	63	37	0	36,900
Household Furniture	251	8	2.4	1,440	80	20	0	94	6	0	60,000
Office Furniture	252	4	100.0	514	100	0	0	62	38	0	500
Partitions and Fixtures	254	6	7.5	260	94	6	0	86	14	*	3,400
Pulp Mills	261	1	44.5	3,393	18	82	*	1	99	0	7,600
Paper Mills, Except Building Paper	262	4	40.5	3,931	77	23	0	42	58	0	9,700
Paperboard Mills	263	5	32.2	5,052	49	51	*	42	58	0	15,600
Misc. Converted Paper Products	264	5	2.9	985	67	33	0	56	44	0	33,900
Paperboard Containers and Boxes	265	3	1.9	2,493	37	63	0	99	1	0	131,200
Newspapers	271	5	1.3	400	100	0	0	78	22	0	30,700
Periodicals	272	3	29.6	293	100	0	0	100	0	0	1,000
Books	273	1	10.0	638	100	0	0	75	25	0	6,400
Misc. Publishing	274	1	NA	117	100	0	0	100	0	0	NA
Commercial Printing	275	13	6.2	736	100	0	0	99	1	0	11,800

Table 9 (continued)

Industry	SIC Code	Respondents: Number	Respondents: % Industry Employment	Respondents: Energy Used (10^7 BTU's)	Respondents Percent Fuel Type: Gas	Diesel	Other	Respondents Percent Functional Use: On-Road Use	Off-Road Use	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Manifold Business Forms	276	6	38.0	182	100	0	0	100	0	0	500
Blankbooks and Bookbindings	278	5	18.0	445	100	0	0	99	1	0	2,400
Industrial Chemicals	281	12	50.1	5,632	87	13	0	71	25	4	11,200
Plastics Materials and Synthetics	282	6	35.8	752	90	10	0	87	13	0	2,100
Drugs	283	4	17.4	97	100	0	0	41	59	0	650
Soap, Cleaners and Toilet Goods	284	12	28.3	2,448	59	41	0	80	16	4	8,650
Paints and Allied Products	285	5	20.4	511	100	0	0	58	42	0	2,500
Gum and Wood Chemicals	286	3	9.4	156	100	0	0	62	38	0	1,650
Agricultural Chemicals	287	1	3.3	25	100	0	*	19	81	0	750
Misc. Chemical Products	289	6	6.9	376	80	20	0	90	10	0	5,450
Paving and Roofing Materials	295	9	98.1	9,928	61	39	0	51	49	0	10,100
Tires and Inner Tubes	301	4	100.0	5,607	59	41	0	73	27	0	5,600
Fabricated Rubber Products	306	4	21.4	1,974	44	56	0	97	3	0	9,200
Misc. Plastics Products	307	4	10.7	171	87	13	*	100	0	0	1,600
Footwear, Except Rubber	314	4	31.1	259	100	0	0	89	11	0	850
Handbags and Personal Leather Goods	317	1	67.6	342	100	0	0	100	0	0	500
Leather Goods, N.E.C.	319	2	36.0	16	100	0	0	100	0	0	40
Glass and Glassware Pressed or Blown	322	2	1.0	43	100	0	0	90	10	0	430
Products of Purchased Glass	323	3	40.3	9,634	51	49	0	98	1	1	23,900
Cement, Hydraulic	324	1	36.9	3,365	7	93	0	27	70	3	9,100
Structural Clay Products	325	12	62.0	15,867	50	50	0	46	43	11	25,600
Pottery and Related Products	326	3	72.8	897	70	30	0	98	2	0	1,230
Concrete, Gypsum, and Plaster Products	327	15	8.2	8,640	57	43	0	91	8	1	105,350

Table 9 (continued)

Industry	SIC Code	Respondents Number	Respondents % Industry Employment	Respondents Energy Used (10^7 BTU's)	Respondents Percent Fuel Type Gas	Diesel	Other	Respondents Percent Functional Use On-Road Use	Off-Road Use	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Cut Stone and Stone Products	328	6	5.3	524	99	1	0	93	7	0	10,000
Misc. Nonmetallic Mineral Products	329	8	91.8	2,739	90	10	0	48	51	1	3,000
Blast Furnace and Basic Steel Products	331	6	85.0	3,631	85	15	0	48	52	0	4,250
Iron and Steel Foundries	332	6	58.9	1,026	90	10	0	37	63	0	1,750
Drawing of Metals	335	7	36.9	15,878	53	47	0	69	31	0	43,000
Nonferrous Foundries	336	2	27.2	150	100	0	0	85	15	0	550
Cutlery, Hand Tools and Hardware	342	3	4.9	37	100	0	0	100	0	0	750
Plumbing and Heating, Except Electric	343	4	49.1	230	100	0	*	81	19	0	470
Fabricated Structural Metal Products	344	17	7.1	4,058	86	14	0	81	19	*	57,150
Metal Stampings	346	6	42.1	2,809	79	21	0	75	25	0	6,670
Metal Services, N.E.C.	347	5	28.3	361	81	19	0	51	49	0	1,270
Misc. Fabricated Wire Products	348	3	47.2	2,195	80	20	0	76	22	2	4,650
Misc. Fabricated Metal Products	349	8	83.7	837	83	17	0	87	13	0	1,000
Farm Machinery	352	6	45.6	5,051	59	41	0	78	22	0	11,050
Construction and Related Machinery	353	3	9.0	1,435	75	25	0	52	48	0	15,950
Metalworking Machinery	354	4	8.1	198	100	0	0	86	13	1	2,450
Special Industry Machinery	355	5	2.0	235	96	14	0	87	13	0	1,180
General Industrial Machinery	356	4	12.4	1,275	100	0	0	88	12	0	10,300
Office and Computing Machines	357	1	20.2	10	100	0	0	100	0	0	50

Table 9 (continued)

Industry	SIC Code	Respondents: Number	Respondents: % Industry Employment	Respondents: Energy Used (10^7 BTU's)	Respondents Percent Fuel Type: Gas	Diesel	Other	Respondents Percent Functional Use: On-Road Use	Off-Road Use	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Service Industry Machines	358	4	30.5	3,762	78	22	0	90	10	0	12,300
Misc. Machinery, Except Electrical	359	10	6.7	755	100	0	0	93	7	*	11,250
Electric Test and Distributing Equipment	361	10	23.8	1,477	77	23	0	70	30	0	6,200
Electrical Industrial Apparatus	362	3	24.3	69	100	0	*	44	56	0	280
Household Appliances	363	1	20.9	15	100	0	*	87	13	0	70
Electric and Wiring Equipment	364	4	16.0	673	100	0	0	75	25	0	4,200
Radio and TV Receiving Equipment	365	1	76.6	64	100	0	0	100	0	0	80
Communication Equipment	366	1	76.2	149	100	0	0	80	20	0	200
Electronic Components and Accessories	367	1	48.9	569	75	25	0	28	*	72	1,150
Misc. Electrical Equipment and Supplies	369	3	5.1	378	100	0	0	98	2	0	7,400
Motor Vehicles and Equipment	371	8	48.9	14,569	100	0	0	81	19	0	29,800
Aircraft and Parts	372	4	92.0	4,777	87	13	0	66	34	*	5,200
Ship and Boat Building and Repairing	373	2	55.5	1,300	60	40	0	74	26	0	2,350
Misc. Transportation Equipment	379	7	6.1	3,313	81	19	0	78	22	0	54,300
Mechanical Measuring, Control Devices	382	2	74.9	298	100	0	0	98	2	0	400
Medical Instruments and Supplies	384	3	17.2	178	96	4	0	83	17	0	1,050
Watches, Clocks, and Watchcases	387	2	13.3	269	100	0	0	100	0	0	2,000

Table 9 (continued)

Industry	SIC Code	Respondents: Number	Respondents: % Industry Employment	Respondents: Energy Used (10^7 BTU's)	Respondents Percent Fuel Type: Gas	Diesel	Other	Respondents Percent Functional Use: On-Road Use	Off-Road Use	Other	Estimated Total Industry Energy Consumption (10^7 BTU's)
Toys and Sporting Goods	394	4	19.1	252	100	0	0	98	2	0	1,300
Pens, Pencils, Office and Art Supplies	395	6	24.3	861	13	87	0	67	30	3	3,550
Costume Jewelry and Notions	396	1	20.0	102	100	0	0	97	3	0	500
Misc. Manufactures	399	4	21.5	1,897	85	15	0	99	1	0	8,800
Total		555	20.3	303,590	81	19	*	79	20	1	2,806,130

Table 10

ENERGY COSTS FOR RESPONDENTS BY INDUSTRY, 1973

Industry	SIC Code	Plant Energy Costs: Number Respondents	Plant Energy Costs: Respondents % Industry Employment	Plant Energy Costs: Energy Cost ($000)	Transportation Energy Costs: Number Respondents	Transportation Energy Costs: Respondents % Industry Employment	Transportation Energy Costs: Energy Cost ($000)
Meat Products	201	13	13.3	877	4	7.6	358
Dairy Products	202	6	26.3	4,805	5	25.8	497
Canned, Cured, and Frozen Foods	203	2	15.3	146	1	7.5	47
Grain Mill Products	204	10	7.5	217	5	4.3	271
Bakery Products	205	10	35.4	1,231	2	23.3	820
Confectionery and Related Products	207	8	58.2	789	3	24.9	117
Beverages	208	12	26.1	5,720	9	7.8	180
Misc. Foods and Kindred Products	209	9	20.9	572	4	16.1	35
Weaving Mills, Cotton	221	9	24.2	4,732	9	24.2	49
Weaving Mills, Synthetic	222	10	61.0	1,721	8	56.6	47
Narrow Fabric Mills	224	4	38.2	120	1	1.6	1
Knitting Mills	225	11	22.2	776	8	14.4	27
Textile Finishing, except Wool	226	5	25.8	1,113	3	11.8	10
Floor Coverings Mills	227	25	15.0	5,033	22	11.5	259
Yarn and Thread Mills	228	12	12.8	1,391	8	10.4	36
Misc. Textile Goods	229	8	30.3	2,020	7	30.1	17
Men's and Boy's Suits and Coats	231	6	43.0	341	5	39.4	17
Men's and Boy's Furnishings	232	12	8.3	271	8	6.6	60
Women's and Misses' Outerwear	233	9	12.4	85	6	7.8	7
Women's and Children's Undergarments	234	4	8.3	72	2	6.3	1

Table 10 (continued)

Industry	SIC Code	Plant Energy Costs			Transportation Energy Costs		
		Number Respondents	Respondents % Industry Employment	Energy Cost ($000)	Number Respondents	Respondents % Industry Employment	Energy Cost ($000)
Hats, Caps, and Millinery	235	1	50.4	4	1	50.4	*
Children's Outerwear	236	7	54.5	88	5	39.9	*
Misc. Apparel and Accessories	238	5	34.3	72	3	8.5	*
Misc. Fabricated Textile Products	239	9	9.4	104	8	7.7	24
Logging Camps and Logging Contractors	241	3	0.4	5	17	2.3	189
Sawmills and Planning Mills	242	13	8.8	465	13	8.1	240
Millwork, Plywood and Related Products	243	16	3.8	56	14	3.3	71
Wooden Containers	244	11	61.8	348	9	45.4	64
Misc. Wood Products	249	5	25.6	855	7	27.1	209
Household Furniture	251	9	2.6	53	8	2.4	547
Office Furniture /1	252	4	100.0	1,249	4	100.0	21
Partitions and Fixtures	254	8	12.4	*	6	7.5	*
Pulp Mills	261	1	44.5	4,478	1	44.5	85
Paper Mills, except Building Paper	262	5	40.7	16,456	4	39.2	61
Paperboard Mills	263	6	43.0	9,683	5	32.3	153
Misc. Converted Paper Products	264	6	4.6	325	5	2.9	31
Paperboard Containers and Boxes	265	4	3.9	111	3	3.6	57

* Figure was less than a thousand.

/1 Total industry employment assumed to be equal to employment of respondents. See text for explanation.

Table 10 (continued)

Industry	SIC Code	Plant Energy Costs: Number Respondents	Plant Energy Costs: Respondents % Industry Employment	Plant Energy Costs: Energy Cost ($000)	Transportation Energy Costs: Number Respondents	Transportation Energy Costs: Respondents % Industry Employment	Transportation Energy Costs: Energy Cost ($000)
Newspapers	271	6	1.4	20	5	1.3	4
Periodicals	272	3	29.6	33	3	29.6	9
Books	273	2	12.2	7	-	-	-
Commercial Printing	275	18	6.7	108	13	6.2	28
Manifold Business Forms	276	8	48.4	70	6	3.8	6
Blankbooks and Bookbindings	278	6	19.2	61	5	17.7	15
Printing Trade Services	279	1	2.2	4	-	-	-
Industrial Chemicals	281	17	56.8	11,438	12	49.8	1,927
Plastics Materials and Synthetics	282	9	38.2	1,894	6	35.8	22
Drugs	283	5	17.7	602	4	17.4	6
Soap, Cleaners and Toilet Goods	284	14	32.9	61	12	28.4	86
Paints and Allied Products	285	7	24.5	177	5	20.5	20
Gum and Wood Chemicals	286	3	9.4	151	3	9.4	5
Agricultural Chemicals	287	2	6.3	169	1	3.3	3
Misc. Chemical Products	289	10	14.5	77	6	6.9	14
Paving and Roofing/1 Materials	295	10	98.8	3,326	10	99.4	918
Tires and Inner Tubes/1	301	4	100.0	2,011	4	100.0	120
Fabricated Rubber Products	306	4	21.4	225	3	19.4	84
Misc. Plastics Products	307	5	10.8	387	4	10.7	9
Footwear, except Rubber	314	6	47.7	169	4	31.1	8
Handbags and Personal Leather Goods	317	2	91.1	21	1	67.6	6
Leather Goods, N. E. C.	319	3	60.0	12	2	36.0	1

/1 Total industry employment assumed to be equal to employment of respondents. See text for explanation.

Table 10(continued)

Industry	SIC Code	Plant Energy Costs: Number Respondents	Plant Energy Costs: Respondents % Industry Employment	Plant Energy Costs: Energy Cost ($000)	Transportation Energy Costs: Number Respondents	Transportation Energy Costs: Respondents % Industry Employment	Transportation Energy Costs: Energy Cost ($000)
Glass and Glassware Pressed or Blown	322	2	1.0	11	2	1.0	12
Products of Purchased Glass	323	4	42.3	161	3	40.3	208
Cement. Hydraulic	324	1	-	2,159	1	-	36
Structural Clay Products	325	12	62.0	4,241	12	62.0	276
Pottery and Related Products	326	4	86.2	245	3	72.8	18
Concrete, Gypsum, and Plaster Products	327	16	8.8	235	16	8.5	204
Cut Stone and Stone Products	328	8	6.0	34	7	5.5	19
Misc. Nonmetallic Mineral Products	329	10	93.5	4,778	8	91.9	126
Blast Furnace and Basic Steel Products	331	7	94.6	4,763	6	85.0	69
Iron and Steel Foundries	332	7	60.0	950	6	58.9	56
Drawing of Metals	335	8	38.5	2,042	7	36.9	476
Nonferrous Foundries	336	5	80.0	149	2	27.2	4
Cutlery, Hand Tools and Hardware	342	3	4.9	5	3	4.9	1
Plumbing and Heating, Except Electric	343	4	49.1	130	4	49.1	8
Fabricated Structural Metal Products	344	21	8.4	434	17	7.2	156
Metal Stampings	346	6	42.1	563	5	54.4	93
Metal Services, N.E. C.	347	6	30.0	319	5	28.3	10
Misc. Fabricated Wire Products	348	4	54.0	220	3	47.3	62

Table 10 (continued

Industry	Code	Plant Energy Costs: Number Respondents	Plant Energy Costs: Respondents % Industry Employment	Plant Energy Costs: Energy Cost ($000)	Transportation Energy Costs: Number Respondents	Transportation Energy Costs: Respondents % Industry Employment	Transportation Energy Costs: Energy Cost ($000)
Misc. Fabricated Metal Products	349	9	34.7	89	8	83.8	29
Farm Machinery	352	6	45.6	231	6	45.6	126
Construction and Related Machinery	353	5	15.3	51	4	9.2	40
Metalworking Machinery	354	4	8.1	27	4	8.1	7
Special Industry Machinery	355	7	2.9	43	5	2.0	8
General Industrial Machinery	356	8	96.0	97	4	86.8	21
Office and Computing Machines	357	2	57.1	75	1	20.2	30
Service Industry Machines	358	5	31.6	270	5	32.9	105
Misc. Machinery, Except Electrical	359	10	6.7	34	10	6.7	29
Electric Test and Distributing Equipment	361	10	23.8	382	9	22.2	49
Electrical Industrial Apparatus	362	3	24.3	80	3	24.3	4
Household Appliances	363	1	20.9	21	1	20.9	1
Electric and Wiring Equipment	364	4	16.0	78	4	16.0	19
Radio and TV Receiving Equipment	365	1	76.6	4	1	76.6	3
Communication Equipment	366	2	87.8	161	1	76.2	4
Electronic Components and Accessories	367	1	48.9	20	-	-	-
Misc. Electrical Equipment and Supplies	369	4	11.0	578	3	5.2	8
Motor Vehicles and Equipment	371	10	58.4	1,432	9	49.1	416
Aircraft and Parts	372	5	93.0	3,032	4	92.1	129

Table 10 (continued)

Industry	Code	Plant Energy Costs: Number Respondents	Plant Energy Costs: Respondents % Industry Employment	Plant Energy Costs: Energy Cost ($000)	Transportation Energy Costs: Number Respondents	Transportation Energy Costs: Respondents % Industry Employment	Transportation Energy Costs: Energy Cost ($000)
Ship and Boat Building and Repairing	373	2	55.5	85	2	55.5	19
Misc. Transportation Equipment	379	8	6.4	59	7	6.2	95
Mechanical Measuring, Control Devices	382	2	74.9	112	2	74.9	8
Medical Instruments and Supplies	384	3	17.2	47	3	17.2	6
Watches, Clocks, and Watchcases	387	2	13.3	39	2	13.3	3
Toys and Sporting Goods	394	6	21.5	37	4	19.1	10
Pens, Pencils, Office and Art Supplies	395	7	25.7	142	6	24.3	32
Costume Jewelry and Notions	396	1	20.0	106	1	20.0	3
Misc. Manufactures	399	5	21.9	47	4	21.6	59

Table 11

STORAGE CAPACITY FOR FUELS BY INDUSTRY FOR RESPONDENTS, 1973

Industry	SIC Code	Fuel Oil: Number Respondents	Fuel Oil: Average Storage (gallons)	Fuel Oil: Storage as % Annual Consumption	Liquid Propane Gas: Number Respondents	Liquid Propane Gas: Average Storage (gallons)	Liquid Propane Gas: Storage as % Annual Consumption
Meat Products	201	5	77,420	21	3	2,000	95
Dairy Products	202	3	8,334	27	0	0	0
Canned, Cured, and Frozen Foods	203	1	36,500	57	1	30,000	99
Grain Mill Products	204	2	2,500	27	1	1,000	50
Bakery Products	205	3	18,500	134	2	2,400	183
Confectionery and Related Products	207	1	18,000	32	1	51,000	22
Beverages	208	3	8,853	44	0	0	0
Misc. Foods and Kindred Products	209	3	8,267	137	0	0	0
Weaving Mills, Cotton	221	6	103,333	40	2	81,000	88
Weaving Mills, Synthetics	222	2	30,000	58	0	0	0
Narrow Fabric Mills	224	1	20,000	152	0	0	0
Knitting Mills	225	2	5,138	47	2	9,500	29
Textile Finishing, Except Wool	226	4	33,750	74	0	0	0
Floor Covering Mills	227	12	59,000	34	12	16,850	12
Yarn and Thread Mills	228	4	77,750	73	3	667	30
Misc. Textile Goods	229	1	47,000	46	1	72,000	26
Men's and Boys' Suits and Coats	231	0	0	0	0	0	0
Men's and Boys' Furnishings	232	2	4,375	156	0	0	0
Women's and Misses' Outerwear	233	1	1,000	9	1	500	290
Children's Outerwear	236	1	5,000	48	3	533	23
Logging Camps and Logging Contractors	241	1	640	12	3	292	390
Sawmills and Planning Mills	242	1	2,000	15	3	433	45
Millwork, Plywood and Related Products	243	4	413	41	2	300	65

(continued)

Table 11 (continued)

Industry	SIC Code	Fuel Oil: Number Respondents	Fuel Oil: Average Storage (gallons)	Fuel Oil: Storage as % Annual Consumption	Liquid Propane Gas: Number Respondents	Liquid Propane Gas: Average Storage (gallons)	Liquid Propane Gas: Storage as % Annual Consumption
Wooden Containers	244	3	14,833	40	1	1,000	207
Misc. Wood Products	249	1	60,000	103	1	55,200	20
Household Furniture	251	0	0	0	2	300	15
Office Furniture	252	0	0	0	2	750	7
Pulp Mills	261	1	860,000	3	1	8,000	7
Paper Mills, Except Building Paper	262	2	1,687,500	11	0	0	0
Paperboard Mills	263	3	599,000	29	2	2,500	5
Misc. Converted Paper Products	264	1	50,000	142	0	0	0
Paperboard Containers and Boxes	265	1	15,000	25	2	650	11
Books	273	0	0	0	1	1,000	22
Commercial Printing	275	0	0	0	1	250	280
Blankbook and Bookbindings	278	0	0	0	2	1,250	18
Industrial Chemicals	281	7	138,715	32	2	37,750	46
Plastics Materials and Synthetics	282	2	4,375	44	2	775	4
Drugs	283	1	270,000	51	0	0	0
Soap, Cleaners and Toilet Goods	284	2	78,000	43	1	400	04
Gum and Wood Chemicals	286	2	66,650	4,950	1	400	36
Agriculture Chemicals	287	1	36,000	20	0	0	0
Paving and Roofing Materials	295	7	63,085	34	4	30,210	17
Tires and Inner Tubes	301	2	34,290	119	1	500	6
Fabricated Rubber Products	306	0	0	0	2	3,250	11
Footwear, Except Rubber	314	1	5,000	26	2	1,400	20
Structural Clay Products	325	4	162,48	35	4	41,375	80
Pottery and Related Products	326	0	0	0	1	30,000	111
Concrete, Gypsum, and Plaster Products	327	6	7,034	40	5	1,020	65
Cut Stone and Stone Products	328	1	110	110	0	0	0

(continued)

Table 11 (continued)

Industry	SIC Code	Fuel Oil Number Respondents	Fuel Oil Average Storage (gallons)	Fuel Oil Storage as % Annual Consumption	Liquid Propane Gas Number Respondents	Liquid Propane Gas Average Storage (gallons)	Liquid Propane Gas Storage as % Annual Consumption
Misc. Nonmetallic Mineral Products	329	5	202,600	134	0	0	0
Blast Furnace and Basic Steel Products	331	2	175,250	24	2	172,500	266
Iron and Steel Foundries	332	1	31,000	122	3	11,833	40
Nonferrous Rolling and Drawing of Metals	335	2	13,250	93	7	31,120	31
Nonferrous Foundries	336	0	0	0	3	10,417	53
Cutlery, Hand Tools and Hardware	342	0	0	0	2	77	13
Plumbing and Heating, Except Electric	343	2	5,675	38	1	1,000	42
Fabricated Structural Metal Products	344	2	1,250	73	4	680	18
Metal Stampings	346	1	56,000	69	3	6,500	16
Metal Services, N.E.C.	347	0	0	0	1	50,000	56
Misc. Fabricated Wire Products	348	0	0	0	1	500	26
Misc. Fabricated Metal Products	349	0	0	0	1	330	10
Farm Machinery	352	0	0	0	2	2,150	11
Construction and Related Machinery	353	0	0	0	1	250	59
Metalworking Machinery	354	0	0	0	2	225	37
Special Industry Machinery	355	0	0	0	1	1,250	27
General Industrial Machinery	356	0	0	0	2	1,753	29
Service Industry Machines	358	0	0	0	1	30,000	29
Misc. Machinery, Except Electrical	359	1	200	21	0	0	0
Electric Test and Distributing	361	0	0	0	1	250	5
Electrical Industrial Apparatus	362	0	0	0	1	1,000	14

(continued)

Table 11 (continued)

Industry	SIC Code	Fuel Oil: Number Respondents	Fuel Oil: Average Storage (gallons)	Fuel Oil: Storage as % Annual Consumption	Liquid Propane Gas: Number Respondents	Liquid Propane Gas: Average Storage (gallons)	Liquid Propane Gas: Storage as % Annual Consumption
Electric and Wiring Equipment	364	0	0	0	1	95	25
Electronic Components and Accessories	367	0	0	0	1	50	8
Motor Vehicles and Equipment	371	1	145,000	51	6	98,750	68
Aircraft and Parts	372	3	206,167	34	0	0	0
Ship and Boat Building and Repairing	373	1	6,180	25	2	1,100	290
Misc. Transportation Equipment	379	0	0	0	1	125	15
Mechanical Measuring, Control Devices	382	1	200	100	1	1,000	61
Watches, Clocks, and Watchcases	387	0	0	0	1	400	42
Costume Jewelry and Notions	396	1	16,000	100	0	0	0
Misc. Manufactures	399	0	0	0	1	8,000	40

TABLE 12

SUMMARY OF ENERGY CHARACTERISTICS OF VARIOUS GEORGIA INDUSTRIES

SIC [illegible]	Raw Materials	Waste Produced	Percentage Waste	Potential Uses of Wastes	Processes Suspectible to Start-up and Shutdown	Special Safety Precautions which require energy to be used in specific way	Percent of value added represented by cost of energy	Effect of Energy Cost increase on Product cost & market	Effect of fuel cutback on production & employment	Effect of loss on Energy Dependent Inputs
201	Beef & pork parts	None paper & paper ctns.	25%	No potential	None	None	0.4-5.0%	Increase mkt. price possible	Moderate to high influence from use of steam, cookers, refrig	Moderate to high influence from use of steam cookers refrigerate
	Chicken	Blood heads, feet, viscera feathers		Waste & rendering						
208	Glass bottles H_2O, CO_2 cola syrup	Nominal am't. of broken bottles	NA	None	None	None	1%	No effect	Proportionate reduction to coal electricty	Proportionate reduction to coal electricity
209	Peanuts, sugar, glass jars oils, eggs & fruits	Negligible amounts produced	NA	NA	None	None	0.25%	Very little		The price of glass, oils, sugar, eggs, & AC fruit crops increased
221	Cotton fiber, starch & Pkg. materials	nonre-workable & sweep-ings	13% Waste	No other uses (land-filled)	Few problems except for boiler dependent operations: (1) Starch temp. & (2) Drying rolls for the sizer	None	0.4%	Increase somewhat (unesti-mated)	Present coal costs-total energy costs increase by 48% & Production Electric Energy Smilar to coal	None

TABLE 12 (cont'd.)

SIC Number	Raw Materials	Waste Produced	Percentage Waste	Potential Uses of Wastes	Processes Suspectible to Start-up and shutdown	Special Safety Precautions which require energy to be used in specific way	Percent of value added represented by cost of energy	Effect of Energy Cost increase on Product Cost & Market	Effect of fuel cutback on production & employment	Effect of loss on Energy Dependent Inputs
222	Polypropylene vinyl fiber, fiberglass yarn & other synthetic materials cotton	Polyproplene or synthetic & cotton yarn & remnants	8% Waste	Secondary fiber use or small energy conversion source	Minor - starch heating in slasher room	None	2.9% to 4.4%	Considerable need to absorb higher energy costs	Serious results production and employment by a fuel cutback	Reduction of production moderately high
225	Cotton or polyester blend thread	Cotton knit & cotton polyester blend scraps	3.4% Waste	None	None	None	1.1%	None	Air temperature comfort would be the major effect with decreased productivity following proportionate to energy loss	None
226	Cotton Yarn	Cloth Cutting	5% Waste	Energy Conv.	None	None	1.5%	Negligible	Production Reduction	Indeterminate am't. of loss production
227	Nylon, polyester, yarn jute latex foam, syn. fibers, dye & tufted carpet from another plant	Latex wastes carpet trimmings yarn, selvage, boxes	1.5% to 5% Waste	Little (put in days) backing & selvage possibly converted into energy	None	None	0.5% to 9.9%	Negligible affects absorbed by INDUSTRY. Moderate increase results in production decrease	Both elec. & gas (Nat'l. & fuel) shortages would be seen in proportional reductions in production & employment	Since industry is fuel-dependent, a direct change would be seen in availability of materials & production

TABLE 12 (cont'd.)

SIC Number	Raw Materials	Waste Produced	Percentage Waste	Potential Uses of Wastes	Processes Suspectible to Start-up and Shutdown	Special Safety Precautions which require energy to be used in specific way	Percent of value added represented by cost of energy	Effect of Energy Cost increase on Product cost & market	Effect of fuel cutback on production & employment	Effect of loss on Energy Dependent Inputs
262	Scrap Corregated	Dirt, metal, styrofoam staples, tape	15%	Little or none	None	None	16%	Cost increase reflected in market	None	Direct loss seen in production
263										
281	Chlorine, Caustic Soda	Cardboard Polyethylene	NA	Reprocessing for paper products None	None	None	0.2%	Recent increases have been absorbed significant costs would be passed to market	Cutback on gas affects the bldg. temp. comfort of workers	Moderate to high effects from chemical shortages
287	Ground phosphate rock sulfuric acid Nitrogen solution Ammonia as ammonia Granular fertilizer	Fertilizer mud from the scrubber is produced in some operations	.134% Waste	Recycle by flocculation to the ammoniator	Plant is designed to operate continuously; significant decline in efficiency if operations stop and start	In some plants fuel interruptions could present some safety problems if automatic equipment failed to operate properly	NA, NA, 3%	Some costs would be absorbed and significant ones would be passed to customers	Production cutback would be a major result; minor reduction of employees needed would also result	Natural gas shortage threatening nitrogen solution sources would reduce production in many industries

TABLE 12 (cont'd.)

SIC Number	Raw Materials	Waste Produced	Percentage Waste	Potential Uses of Wastes	Processes Suspectible to Start-up and Shutdown	Special Safety Precautions which require energy to be used in specific way	Percent of value added represented by cost of energy	Effect of Energy Cost increase on Product cost & market	Effect of fuel cutback on production & employment	Effect of loss on Energy Dependent Inputs
295	Heavy petroleum-tars Limestone	None	0% Waste	None	None	None	4 -5%	Some, but likely a nominal increase in cost would be passed to market value	Little, if at all	None
324	Limestone & Fuller's earth clay & iron ore	None	0% Waste	None	Kiln requires high am't. energy for startup	None	20%	Cost would be passed on to market cost	None	Serious problem involved by threatened energy dependent inputs
32[illegible]	[illegible], sand, cement, [illegible] & water misc. steel supplies	Broken block [illegible]stone fues	875% Waste	None	None	None	2.2% to 3.45%	Increase of product pace if significance energy cost increase occurred	Proportionate reduction in production & employees to that cutback of fuel	Cement reduction would influence a production cutback
3[illegible]	Steels, stainless steels, welding, rod & wire argon & [illegible] compounds	Lathe turnings pieces of tubing	1.9% Waste	Efficient reclamation process in effect	None	None	1.0%	None	Insignificant if any	Little or none
335	Aluminum [illegible] [illegible] alloying elements chemicals for anodizing	Negligible	NA	-	None	None	2.4%	None	None	None

TABLE 12 (cont'd.)

SIC Number	Raw Materials	Waste Produced	Percentage Waste	Potential Uses of Wastes	Processes Suspectible to Start-up and Shutdown	Special Safety Precautions which require energy to be used in specific way	Percent of value added represented by cost of energy	Effect of Energy Cost increase on Product cost & market	Effect of fuel cutback on production & employment	Effect of loss on Energy Dependent Inputs
353	Sheet steel, switches, electric motors, [illegible], heating elements, paint, wire	Cardboard & wood	NA	Small contribution to a pyrolyzer	None, unless insufficient warning to permit clearing materials from ovens	None	3.64%	Increase of product price due to increase in transportation & production, i.e. steel	Reduction of production & employment	Increased market costs because of material costs
371	Fabricated metal parts, steel scrap, polyurethane foam, asbestos cloth, linings, anti-freeze*, fiberglass	Steel & Iron parts, Paper, Wood, Asbestos	NA	Scrap	None	None	.5%	Little or no increase of product price	None	Negligible product cost, if any

TABLE 13

SUMMARY OF PROCESS

UTILIZATION

SIC NUMBER	ELECTRIC PROCESSES	AVERAGE % UTILIZATION	THERMAL PROCESSES	AVERAGE % UTILIZATION
201	Motors & Drives	70	Boiler	63
	Refrigeration	19	Smoke House	9.8
	Lighting	5	Space Heat	9.8
	Space Heat	5.8	Singers	17
208	Air Conditioning	40	Boiler	100
	Conveyors	15		
	Compressors	20		
	Blowers	15		
	Lighting	10		
209	Equipment Drives	90	Boiler	85
	Lighting	10	Building Heat	13
			Cooking	72
			Roaster	15
221	Air Compressors	5	Building Heat & Humidification	85
	Equipment Drives	85		
	Lighting	10	Sizing Applicator & Dryer	15

SIC NUMBER	ELECTRIC PROCESSES	AVERAGE % UTILIZATION	THERMAL PROCESSES	AVERAGE % UTILIZATION
222	Machinery/ Equipment	62	Afterburner	42.7
	Lighting	10	Boiler	41.3
	Heating	1.7	Oven	16
	Air Conditioning	13		
	Blowers	6.7		
	Conveyors	6.7		
225	Motors	50	Boiler	100
	Air Conditioning	40	Heating	85
	Lighting	10	Sizer	10
			Cleaner	5
226	Machinery	50	Boiler	25
	Air Conditioning	30	Dryers	60
	Lighting	10	Plant Heat	15
	Some Heating	10		
227	Equipment	85	Boiler	53
	Lighting	6.9	Dryers	3
	Office Heat	4.1	Coater Ovens	2
	Vents/Fans/Etc.	2	Foam Percolater	.1
	Office Air Conditioning	.1	Foam Curing Oven	20
			Laminating Oven	1.7
			Wet Goods Dryer	2
			Becks	13.
			Makeup Air Heaters	.5
			Plant Heat (other than above)	2.9

SIC NUMBER	ELECTRIC PROCESSES	AVERAGE % UTILIZATION	THERMAL PROCESSES	AVERAGE % UTILIZATION
			Yarn Conditioners	.4
			Miscellaneous	.2
			Oven	.6
228	Equipment Drives	63	Boiler	100
	Lighting	8		
	Air Conditioning	24		
	Air Compressor	6		
262	Motors and Drives	95	Boiler	50
	Lights	5	Dryer	50
263	Process	96	Process	98
	HVAC	4	HVAC	2
281	Equipment Drives	75	Air Conditioning	85
	Electric Forklifts	15	Heating	15
	Lighting	10		
287	Process Equipment	93	Boiler	11.87
	Lights	1	Dryer	85.3
	HVAC	.9	Rotary Kiln	2.04
	Blower	.7	Heating	.568
	Conveyors	1		99.7
	Ammonia Compressor	3		
295	Electric Equipment/ Crushers	95	Tar Heater	36
	Lighting	5	Drive Mining Equipment	10

SIC NUMBER	ELECTRIC PROCESSES	AVERAGE % UTILIZATION	THERMAL PROCESSES	AVERAGE % UTILIZATION
			Hauling Equipment	54
324	Process Equipment	90	Dryer	20
	Lighting	5	Kiln	80
	HVAC	5		
327	Equipment	89	Boilers	42
	Lighting	5	Dryers	7
	Office Air Conditioning	6	Heating	5
			Hot Water Heaters	1
			Truck to Convey Concrete	11
			Mining Equipment	36
329	Blower	60	Calciners	100
	Conveyors Mech.	10		
	Shakers	15		
	Baggers	10		
	Lighting	5		
331	Equipment Drives	30	Heating	45
	Arc Welders	60	Air Conditioning	55
	Lighting	10		
335	Air Conditioning	20	Smelting furnace	40
	Extrusion Press Pumps	15	Aging Ovens	20
	Annodizer	35	Billet Heaters	15

SIC NUMBER	ELECTRIC PROCESSES	AVERAGE % UTILIZATION	THERMAL PROCESSES	AVERAGE % UTILIZATION
	Conveyors	8	Homoginizing Oven	15
	Blowers & Exhaust Fans	8	Boiler	10
	Coding Water Circulation	12		
	Lighting	2		
363	Air Conditioning	15	Primary Dryers	.8
	Lighting/Drives/ Fans	85	Final Dryers	1.6
			Ground Coat	8.1
			Enameling Furnaces	47.5
			Makeup Air Heaters	5.9
			Paint Ovens	10
			Stripper Tank	.8
			Boilers	22.7
			Gas Dryer	1
			Miscellaneous	1
371	Lighting	29	Space Heat	58
	Infrared Oven	7	Boiler	3
	Welders	6	Drying Ovens	13
	Electric Motors/ Equipment	58	Cleaners	9
			Washers	16

TABLE 14

Suggested Energy Savings Methods for Boilers, Lighting and HVAC Equipment

PROCESS	MINOR CHANGES	TYPICAL ESTIMATED PERCENT CHANGES	MAJOR CHANGES	TYPICAL ESTIMATED PERCENT SAVINGS
Boiler:	Combustion Analysis - to adjust excess air	5	Change from natural draft to forced draft burner	10
	Clean oil nozzles every four hours	5	Use steam turbines for boiler auxiliaries	5
	Install accurate control on oil temperature	1	Install economizer	5
	Clean air blower blades	2		
	Repair leaks	1		
	Install correct water treatment program	2		
	Set correct boiler blowdown	2		
	Repair insulation	1		
	Return all condensation	5		
	Keep accurate records	-		
	Install accurate guage	-		
	Repair five bricks	2		
	Keep boiler room and equipment clean	-		
	Check correct pressure in feedwater deaerator heater	2		
	Keep auxiliary equipment motor clean	-		
	Provide adequate combustion air to boiler room	5		
	Install thermostate on boiler room ventilation fan	-		
	Have good boiler room lighting, but secure when not needed	-		
Lighting:	Turn off unneeded lights	up to 20	Change from irridescent to florescent lights	67
	Clean glass fixtures	5	Change from florescent to high pressure sodium lights	50
	Check for correct voltage and adjust if necessary	5	Change from area lighting to task lighting	up to 50
	Reduce lighting level to that needed for task	up to 50	Install sky lights	up to 20

PROCESS	MINOR CHANGES	TYPICAL ESTIMATED PERCENT CHANGES	MAJOR CHANGES	TYPICAL ESTIMATED PERCENT SAVINGS
Lighting (cont.)	Install time clock for outdoor lighting	up to 50		
	Install electric eyes - outdoor lighting	20		
	Install switches so only lights necessary can be used	10		
	Reduce parking lot lights to that required for security after hours	up to 50		
	Turn off lights when you leave room over fifteen minutes	-		
Space Heating:	Replace damaged thermostats	5%/°f over 70°f	Install radiant heaters	up to 50
	Caldrate thermostats	5%/°f over 70°f	Install air curtain door	10
	Install time clocks for nighttime shutdown	20-30		
	Install night thermostats	10-20		
	Lower temperature	5%/°f over 70°f		
	Provide heat only when, where, and to what degree necessary	-		
	Repair - replace steamtraps	10		
	Clean dust and lint from unit heaters	-		
	Insulate steam mains	20		
	Repair leaks	5		
	Reduce ventilation air to meet requirements	10-30		
	Install vent hoods	-		
	Use gravity ventilators	3		
	Rearrange heaters	-		
	Contain heat to needed areas	-		
	Replace filters	5		
Air Conditioners	Install time clock	20-30	Size to needed capacity	10
	Balance air flow to avoid local overcooling	-	Building insulation	20
	Clean evaporators	5	Building shading	10
	Clean cooling tower	5	Install economizer cycle	10
	Check refrigerant level	-	Install air enthadpy control	2

PROCESS	MINOR CHANGES	TYPICAL ESTIMATED PERCENT CHANGES	MAJOR CHANGES	TYPICAL ESTIMATED PERCENT SAVINGS
Air Conditioning (cont.)	Reset thermostat upward	5%/°f		
	Provide cooling only where necessary	-		
	Insulate ductwork	5		
	Reduce outside air to minimum	0-30		
	Replace filters	5		
	Clean blower wheel	2		
	Reduce blower cfm to needed quantity	5		
	Install deadband heating - cooling thermostats	-		
	Check cooling tower blowdown	1		
Blowers:	Cycle off when not needed	-	Install low pressure drop duct	-
	Use lowest cfm requirements	-	Install blower that operates at most efficient point	5
	Clean blower blades	5	Install inlet volume control	10
	Install time clock	-	On large variable volume requirements install variable pitch vane axil fan	0-50
	Check match of motor to fan requirements	1		

201--MEAT PACKING PLANTS

Main Process	Present η	Minor Change $\% \Delta \eta$		Major Change $\% \Delta \eta$		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Smoke Room	60	10	Add isolation, burner proper adjustment	20	Use heat recovery system	No	No	No	No	Solar	
Cookers	60	10	Add insulation	30	Improved Design	Microwave Cooking	No	No	No	Solar	Fuel Oil
Scalders	50	15	Insulate and Inclose	15	Recovered from dumped H_2O	No	No	No	No	Solar	
Refrigeration	65	5	Some of heat removed in the condenser could be used for boiler feed water preheating. Cleaning Condenser	5	Insulate Pipes	No	No	Run Ice Machine at night to avoid peak time. (Conditional if company can store the ice.)	No	Solar	
Clean up of Equipment and Facilities							More use of dry clean up to conserve steam: vacuum cleaning of work areas before steam washing as required under health regulations.		Schedule clean-up to alternate with other operations to best utilize boiler.	Solar heated water for cleaning purposes	

SIC 208

SOFT DRINK COMPANY, MALT LIQUORS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Conveyers	70	10	Cleaning and Maintenance and Lubrication		No	No	No	No	No	Solar energy used for cooling, heating, process energy.	Fuel Oil
Compressors	40	20	Maintenance	30	Add Inter-cooler or Precoolers	No	No	No	No	Solar	Fuel Oil
Blowers	70	10	Cleaning and Maintenance	10	Adding impedence machinery to input and exit.	No	No	No	No	Solar	Fuel Oil

SIC 209

MISCELLANEOUS FOOD PREPARATION AND KINDRED PRODUCTS

Main Process	Present η	Minor Change $\% \Delta \eta$		Major Change $\% \Delta \eta$		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Cooking	60	15	Insulated Cookers	20 15	Pressure cooking with insulated cookers or microwaves	Microwave cooking	No	No	No	Solar for cooking and plant heat.	Fuel Oil
				30	Solar powered focused with rotating cooker-collector						
Roaster	40	10	Modern roaster with heat recovery. Insulate Roaster	30	Microwaves or long wave length infrared in a thin film	Microwave cooking	No	No	No	Solar	Fuel Oil
				50	Focused solar cooker.	Long wave infrared	No	No	No	Solar	
				20	Modern roaster with heat recovery						

SIC 221

BROAD WOVEN FABRIC MILLS, COTTON

Main Process	Present η	Minor Change % $\Delta\eta$ Am't.	Minor Change % $\Delta\eta$ Method	Major Change % $\Delta\eta$ Am't.	Major Change % $\Delta\eta$ Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Building heat and Humidification	63	0	No		No	Open end spinning and modern high speed equipment will conserve energy over the long term	No	No	No	Solar heating and cooling	Fuel Oil
Sizing Applicator and Dryer	30	5	Insulation		Heat Recovery System	No	No	No	No	Fuel Oil	Fuel Oil

SIC 222

BROAD WOVEN FABRIC MILLS, MAN-MADE FIBER AND SILK

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Afterburners	10	30	Decrease air flow from ovens. This adjustment added to meet EPA regulations.	80	Eliminate by circulating exhaust products back through burners and decreasing air flow rate.						Fuel Oil
Ovens	20	50	Decrease air flow through oven.	40	Recirculate exit air through burner, greatly decrease air flow rate and control air flow direction more carefully.	Using outside air for winter air conditioning; Modify oven from 20% of the energy being transferred to the product and 80% exhausted to the stack where it must be heated even further to clean the exhaust. Since only a small amount of combustion products and the oils and gases from the product were to be exhausted, a very minimum amount of air should be admitted to the oven and the exhaust; the exhaust should be reduced until just enough is being exhausted to prevent combustion product vapor from escaping into the area around the oven. Also, infrared microwave ovens should be considered to replace existing ovens.	No	No Scheduling of use of electrical machinery, alteration of work week.	No	Solar energy is ideally suited to the heat set and curing ovens used by this plant. Solar energy could also replace boiler (building heat) and air conditioning.	Fuel Oil
Slashers	60	10	(Bibb)								Fuel Oil

SIC 225

KNITTING MILLS

Main Process	Present η	Minor Change % $\Delta\eta$		Major Change % $\Delta\eta$		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Sizer	60	10	Decrease air flow rate and insulate.	–	–				No		
Washing type	70	10	Decrease air flow rate and insulate.	–	–	More modern electrical motors and knitting machines.	Modern boiler, insulation, power factor correction.	Shifts in summer could be shifted to cooler night times.	No	Solar energy for heating and airconditioning.	Fuel Oil

SIC 226

DYEING AND FINISHING TEXTILES, EXCEPT WOOK FABRICS AND KNIT GOODS

Main Process	Present n	Minor Change % Δ n Am't.	Minor Change % Δ n Method	Major Change % Δ n Am't.	Major Change % Δ n Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Dryer	30	30	Insulation Stop the holes in the walls.	15	Heat recovery system.	Replace old knitting, cutting and sewing operation with new Japanese golve making machines.	No	Evaluate work week; better scheduling of use of dryers.	Proper scheduling and procedure during cool-down cycle of dye becks.	Solar energy offers significant potential as an alternative energy source.	Fuel Oil
Dye-Becks	10	20	Energy recovery systems: 1. Use minimum boil instead of rolling boil in process 2. Having vent fans turned off when steam is not coming off the water surface (photoelectric cell or manual operation)								Fuel Oil

SIC 227

FLOOR COVERING MILLS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Foam Precoater	20	15	Reducing air flow into burner and out of oven.	45	Matching infrared wavelength to later adsorption character- istics sur- face area of radiator.	More use of continuous dyeing. Possible use of solar energy. Thermal radia- tion and high velocity drying ovens offer potential for energy savings. Closed and energy recovery dye beck and continuous dyeing offer potential for saving, exothermic foams and adhesives offer potential for savings.	Exothermic Foam	work only in warm weather; rearrange work week.	Better scheduling of dye beck operation to optimize heat recovery from dumped water. Work only in warm weather.	Possible use of waste materials (saw dust) burned in boiler. Use of solar energy for heating water.	Fuel Oil
Foam Curing Oven	20	20	Reducing air flow by closing dampers	50	Redesign per drawings attached to report to Delta.		Exothermic Foam				Fuel Oil
Laminating Oven	30	15	Reducing air flow by closing dampers	30	Redesign per drawings attached to Delta report.		Exothermic Foam				Fuel Oil
Dryer	20	15	Reducing air flow by closing dampers.	50	Redesign per drawing attached to Delta report.		Combination infrared convective dryer with heat reclamation.				Fuel Oil
Becks	10	5	Reducing air flow rate and turning off beck fans when not boiling.	40	Closing Beck and closed cycle heating and con- densing exhaust and reverse flow heat exchange in dump water line.		Continuous dyer with optimized flour rates or cold dyer or solvent dyer. More continuous dyeing				Fuel Oil

SIC 227

FLOOR COVERING MILLS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Continuous Dyers	30										Fuel Oil
Yarn Conditioners	20	5	Reduce exhaust rate.	40	Insulate control steam rate heat recovery.						Fuel Oil

SIC 228

YARN AND THREAD MILLS

Main Process	Present n	Minor Change % Δ n		Major Change % Δ n		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Humidification	60	10				More efficient motors. Improve power factor.	Same as long term	No	No	Solar energy to heat water and building	Fuel Oil

SIC 281

INDUSTRIAL INORGANIC AND ORGANIC MATERIALS

Main Process	Present η	Minor Change % Δ η		Major Change % Δ η		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Dryer	20	20	Insulate duct work and drying shell.	–	No	No	No	No	No	Solar energy could be used to heat and cool plant eventually	Possible use of waste material fired boiler and fuel oil.
Granulator	50		No	–	No	No	No	No	No		

SIC 287

AGRICULTURAL CHEMICALS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Dryer	20	10	Better design on secondary air injection	30	Eliminate secondary cooling. Use heat exchanger to cool exhaust and preheat drying air.	Redesign of rotary dryer and cooler system (hot gases from cooler to preheat combustion air)	No	No	No	Solar energy could be used to generate steam and drying energy	**Fuel Oil**
Rotary Kiln	20	10	Insulation of kiln		Concentric kilns to use hot dry product to preheat wet product.		No	No	No	No	**Fuel Oil**
Ammonia Compressor	60	–	Insulate ammonia	20	Interstage cooling and using vapor for process first rather than condensing.	No					
Blower	60	10	Keep blower clean and in good condition.	20	Better blade design and better inlet design and matching blower speed to needs						

SIC 295

PAVING AND ROOFTING MATERIALS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Tar Heater	60	10	Better insulation.	-	No		No	No	No	Fuel Oil	Fuel Oil
Drive Mining Equipment	15	-	No	10	Larger, more modern equipment.	Relocation of conveyor to bottom of quarry will conserve considerable energy. A second, very large conveyor should be installed to move large limestone to rail line for shipment to cement plants. The rotary kiln could be modified to preheat the combustion air.	No	No	No		
Hauling Equipment	15	30	Shorter hauling distance.	50	Completely conveyorized hauling.		No	No	No		
Equipment Drivers and Crushers	40	10	Power factor correction and load levels.	10	Matching load to drivers.		Power factor correction	No	No		

SIC 329

ABRASIVE, ASBESTOS, AND MISCELLANEOUS NONMETALLIC MINERAL PRODUCTS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Calciners	33	33	Put shroud around each section on calciner and pull combustion air between calciner and shroud. Improve insulation	33	Put shroud around each section on calciner and pull air between calciner and shroud. Better insulation	Only 33% of the input energy goes into removing the lattice moisture, in the calciners. 67% of the energy can be recovered in the following ways: I. RECOVERY OF ENERGY IN EXHAUST PRODUCTS: (1) Duct gases through one or more auxilliary chambers to preheat the kaolin before it enters the calciner. (2) Duct exhause gases through heat exchanger to preheat combustionairs.	II. RECOVERY OF ENERGY LOST FROM CLACINER SURFACE: (1) Put a shroud around each section on calciner and puss combustion air between calciner and shroud; (2) Install more insulation in calciner. III. RECOVERY OF ENERGY LEAVING WITH PRODUCT: (1) Use a rotary (kiln type) heat exchanger to preheat incoming product with outgoing product. (2) Use a rotary (Kiln type) heat exchanger to preheat combustion air.	NO	NO	Solar energy could provide the temperature levels needed although it would require a large facility using concentrators. Microwave energy should be investigated to determine whether the lattice moisture can be removed without heating the product.	Fuel Oil
Shakers	70	4	Better maintenance	4				NO	NO		N/A
Baggers	50	5	Better maintenance	5				NO	NO		N/A

SIC 331

BLAST FURNACES, STEEL WORKS, AND ROLLING AND FINISHING MILLS

Main Process	Present η	Minor Change % $\Delta \eta$		Major Change % $\Delta \eta$		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Arc Welders	40	5	Proper maintenance & matching welder to needs	10	Automatic programmed welders & power factor correction	Numerically controlled fabrication equipment will improve efficiency.	Electrolytic polishing will increase efficiency.	NO	NO	Solar energy for space heating and air conditioning	N/A

SIC 335

ROLLING, DRAWING, AND EXTRUDING OF NONFERROUS METALS

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Smelting Furnace	30	15	Refer to explanation of Long Term Alternative Process	15	Refer to explanation of Long Term Alternative Process	The smelting furnac e should be equipped with baffler to increase the energy transferred to the aluminum and decrease temperature of the exhaust gases. The exhaust gases should be used to preheat the pas-air mixture before burning. A firebrick or transit door should be used to close the loading opening. It is estimated that energy consumption can be reduced by 50% if these measures are taken. The burner of the homogenizing oven uses 13.6% excess oxygen; oxygen consumption for it should be corrected to use 4%. A heat exchanger should also be used for the exhause to preheat the combustion mixture. The extrusion press, aging ovens should be corrected.		Adjust work shifts to use electrical energy in off-peak hours. This will conserve energy in the generating plant.	NO	Solar energy could be used for both heating and cooling the annodizing system and building.	Fuel Oil
Aging Ovens	37	37		37					NO		Fuel Oil
Billet Heaters	20	50		50					NO		Fuel Oil
Honogenizing Oven	63			0					NO		Fuel Oil
ELECTRICAL											
Extrustion press pumps	50	2	Better maintenance Power factor connection	-	NO				NO		N/A
Annodizer	60	0							NO		N/A
Cooling water circulation station	70	7	Maintenance	-	NO				NO		N/A

SIC 324

CEMENT, HYDRAULIC

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Dryer	70	-	No	-	No	No	Use waste heat for drying material and office heating.	Work week scheduling	No	Fuel Oil	Fuel Oil
Kiln	70	-	No	5	Some process to the feed.	No	Use waste heat for office heating and drying material.	Work week scheduling	No	Fuel	Fuel Oil

SIC 327

CONCRETE, GYPSUM AND PLASTER PRODUCTS

Main Process	Present η	Minor Change % $\Delta\eta$ Am't.	Minor Change Method	Major Change % $\Delta\eta$ Am't.	Major Change Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Dryer	20	10	Insulate drying kilns	60	Use concentrated solar energy to provide drying energy.	Exothermic additives may make possible room temperature curing. Move concrete plant to cast plant. Use electrically heated beds, or a new well design hot water system.	Install conveyors between concrete plant and casting plant. Insulate and seal beds on which the molds are presently heated. The steam in the beds should be reclaimed, better directed and contained. Insulate boiler steam lines. Close doors of the back room. Insulate outside of kiln wells. Put better doors on kiln.	Schedule operation primarily for summer.	No	Fuel Oil	Fuel Oil
Hot Water Heaters	80	0	No	-	Use concentrated solar energy to heat water.				No	Fuel Oil	Fuel Oil
Truck to Convey Concrete from Cement Plant to molds	10	10	Use much larger trucks on paved road.	80	Move cement plant adjacent to mold plant and use conveyors.				No	Fuel Oil	
Mining Equipment	15	2	Better maintenance	10	Preventing maintenance				No	Solar heating of water and building	

SIC 262

PAPER MILLS EXCEPT BUILDING MILLS

Main Process	Present n	Minor Change % Δ n Am't.	Minor Change % Δ n Method	Major Change % Δ n Am't.	Major Change % Δ n Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Dryer	30	20	Enclose to side wall.	30	Heat recovery system	No	No	No	No	Solar heating	Fuel Oil
			Insulate top.							Microwave	
			Cut down on exhaust.								
Pulper	30	15	Enclosing top. Insulating pulper.		No	Nozzles and agitation	No	No	No	Infrared	

New equipment, paper making and drying machines

SIC 363

HOUSEHOLD APPLIANCES

Main Process	Present η	Minor Change % Δ η Am't.	Minor Change % Δ η Method	Major Change % Δ η Am't.	Major Change % Δ η Method	Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
Primary Dryers	30%	20	Decrease air flow take	40	Decrease air flow rate & use heat reclamation equipment	Equipment modification	NO	NO	NO		Fuel Oil
Final Dryers	30%	20	Decrease air flow rate	40	"	Equipment modification	NO	NO	NO		Fuel Oil
Ground Coat	30%	20	Decrease air flow rate	40	"	Equipment modification	NO	NO	NO		Fuel Oil
Enameling Furnaces	10%	20	Waste heat recovery system	80	Modify Equipment & use waste heat recovery system	Equipment modification	NO	NO	NO		Fuel Oil
Make Up Air Heaters	100%	20	Decrease need Modification of exhaust system needs will result in reduction & make up air heater rerequirements	95	Estimate need by modifications to other equipment	Equipment modification	NO	NO	NO		Fuel Oil
Paint Ovens	30_	20	Decrease air flow rate	40	Decrease air flow rate & use heat reclamation equipment	Equipment for heat reclamation	NO	NO	NO		Fuel Oil
Stripper Tank	30%	10	Use waste heat from other processes	10	Use waste heat from other processes	Equipment for heat reclamation	NO	NO	NO		N/A
Boilers	83.8%	θ	NO	--	NO	NO	NO	NO	NO		Fuel Oil
Gas Dryer	30%	20	Decrease air rate & use heat reclamation equip.	20	Decrease air flow rate & use heat rec. equip.	Equipment for heat reclamation	NO	NO	NO		Fuel Oil

SIC 371

MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT

Main Process	Present η	Minor Change % $\Delta\eta$		Major Change % $\Delta\eta$		Long Term Alternative Process	Short Term Alternative Process	Long Term Alternative Scheduling	Short Term Alternative Scheduling	Long Term Alternative Fuel	Short Term Alternative Fuel
		Am't.	Method	Am't.	Method						
Washers	50	10	Insulate cleaner cabinets better	20	Use hot air from around cleaners to heat plant or to pre-heat air for cleaners	NO	NO	NO	NO	Solar energy to heat the building and water for the washers	N/A
Drying Ovens	20	10	Better insu-lation & less air exhaust & using air around drying oven to heat plant or pre-heat air for dryer	30	Use gas fired infrared dryer with recircu-lation system to provide additional confective drying	Dip pre-coat & powder coating.	Dip pre-coat & powder coating.	NO	NO		Fuel Oil
Infrared Drying Oven	30	0	NO	20	Match rad-iator wave-length to paint adsorption characteristics	High voltage dip painting or powder painting		NO	NO		Fuel Oil

TABLE 16

ESTIMATED ENERGY CONSERVATION POTENTIALS FOR VARIOUS GEORGIA INDUSTRIES

SIC Numbers	Present Consumption: Electrical BTU % Use Barrels	Present Consumption: Thermal BTU % Use Barrels	Major Improvements: Electrical Am't.	%	Major Improvements: Thermal Am't.	%	Minor Improvements: Electrical Am't.	%	Minor Improvements: Thermal Am't.	%
201	4.11×10^{12} BTU 32% 2.02×10^{6} BBL	8.74×10^{12} BTU 68% 1.43×10^{6} BBL	3.20×10^{11} BTU 157,603 BBL	18%	1.74×10^{12} BTU 286,196 BBL	20%	3.20×10^{11} BTU 157,603 BBL	18%	1.52×10^{12} BTU 250,250 BBL	17%
208	9.74×10^{2} BTU 33% 4.79×10^{6} BBL	1.98×10^{13} BTU 67% 3.24×10^{6} BBL	1.31×10^{12} BTU 646,915 BBL	14%	0 BTU 0 BBL	0	9.25×10^{11} BTU 455,236 BBL	9.5%	0 BTU 0 BBL	0
209	1.10×10^{13} BTU 24% 5.43×10^{6} BBL	3.50×10^{13} BTU 76% 5.73×10^{6} BBL	1.05×10^{12} BTU 516,087 BBL	9.5%	1.26×10^{13} BTU 2,058,610 BBL	36%	1.05×10^{12} BTU 516,087 BBL	9.5%	1.10×10^{13} BTU 1,800,570 BBL	31%
221	5.72×10^{12} BTU 44% 2.81×10^{6} BBL	7.27×10^{12} BTU 56% 1.19×10^{6} BBL	5.43×10^{11} BTU 267,187 BBL	9.5%	4.87×10^{11} BTU 79,943.1 BBL	6.7%	2.85×10^{10} BTU 14,062.5 BBL	.5%	4.87×10^{11} 799943.1 BBL	6.7%
222	6.58×10^{12} BTU 38% 3.24×10^{6} BBL	1.07×10^{13} BTU 62% 1.76×10^{6} BBL	7.90×10^{11} BTU 388,828 BBL	12%	1.07×10^{12} BTU 861,486 BBL	49%	7.46×10^{11} BTU 367,278 BBL	11%	2.79×10^{12} BTU 457,266 BBL	26%
225	1.32×10^{13} BTU 11% 6.50×10^{6} BBL	1.06×10^{14} BTU 89% 1.75×10^{7} BBL	3.37×10^{12} BTU 1,656,320 BBL	26%	5.23×10^{13} BTU 8,583,730 BBL	49%	2.44×10^{12} BTU 1,201,640 BBL	19%	5.23×10^{13} BTU 8,583,730 BBL	49%

TABLE 16 (Cont'd.)

SIC Numbers	Present Consumption: Electrical BTU % Use Barrels	Present Consumption: Thermal BTU % Use Barrels	Major Improvements: Electrical Am't.	%	Major Improvements: Thermal Am't.	%	Minor Improvements: Electrical Am't.	%	Minor Improvements: Thermal Am't.	%
226	3.67×10^{13} BTU	7.13×10^{13} BTU	2.02×10^{12} BTU		2.89×10^{13} BTU		7.35×10^{11} BTU		2.25×10^{13} BTU	
	34%	66%								
	18,072,300 BBL	11,693,800 BBL	993,976 BBL	5.5%	4,736,000 BBL	41%	361,446 BBL	2%	3,683,560 BBL	32%
227	3.23×10^{13} BTU	1.47×10^{14} BTU	2.66×10^{12} BTU		2.73×10^{13} BTU		2.22×10^{11} BTU		9.62×10^{12} BTU	
	18%	82%								
	15,888,300 BBL	24,126,600 BBL	1,310,220 BBL	8%	4,478,780 BBL	19%	109,152 BBL	.7%	1,578,030 BBL	65%
228	7.30×10^{12} BTU	7.91×10^{12} BTU	5.43×10^{11} BTU		1.19×10^{12} BTU		4.98×10^{11} BTU		1.19×10^{12} BTU	
	48%	52%								
	3,594,890 BBL	1,298,160 BBL	267,083 BBL	7%	195,892 BBL	15%	245,154 BBL	6.8%	95,892 BBL	15%
262	2.07×10^{13} BTU	8.86×10^{12} BTU	5.17×10^{10} BTU		1.91×10^{12} BTU		5.17×10^{10} BTU		1.46×10^{12} BTU	
	70%	30%								
	10,175,100 BBL	1,453,590 BBL	25437.7 BBL	.25%	312,521 BBL	22%	25437.7 BBL	.25%	239,842 BBL	17%
263	1.86×10^{12} BTU	5.59×10^{12} BTU	0 BTU		0 BTU		0 BTU		0 BTU	
	25%	75%								
	916,487 BBL	916,487 BBL	0 BBL		0 BBL		0 BBL		0 BBL	0
281	2.09×10^{12} BTU	4.87×10^{12} BTU	1.67×10^{11} BTU		6.20×10^{11} BTU		1.04×10^{10} BTU		4.14×10^{11} BTU	
	30%	70%								
	1025970 BBL	797979 BBL	82077.9 BBL	8%	101,742 BBL	13%	5,129.87 BBL	.5%	67,828.2 BBL	8.5%
287	3.20×10^{11} BTU	1.68×10^{12} BTU	3.93×10^{9} BTU		2.57×10^{11} BTU		1.72×10^{9} BTU		1.69×10^{11} BTU	
	16%	84%								
	157464 BBL	275561 BBL	1931.61 BBL	1.2%	42,170.4 BBL	15%	846.681 BBL	.5%	27,714.6 BBL	10%

TABLE 16 (cont'd.)

SIC Numbers	Present Consumption: Electrical BTU % Use Barrels	Present Consumption: Thermal BTU % Use Barrels	Major Improvements: Electrical Am't.	%	Major Improvements: Thermal Am't.	%	Minor Improvements: Electrical Am't.	%	Minor Improvements: Thermal Am't.	%
295	3.39×10^{11} BTU 8% 166,911 BBL	3.90×10^{12} BTU 92% 639,827 BBL	3.31×10^{10} BTU 16,73.9 BBL	9.8%	1.23×10^{12} BTU 202185 BBL	32%	3.30×10^{10} BTU 16273.9 BBL	9.8%	6.32×10^{11} BTU 103,652 BBL	16%
324	1.70×10^{11} BTU 6% 83849.3 BBL	2.67×10^{12} BTU 94% 43,788 BBL	8.09×10^{9} BTU 3982.84 BBL	4.8%	0 BTU 0 BBL	0	4.26×10^{8} BTU 209.623 BBL	.25%	0 BTU 0 BBL	0
327	5.70×10^{12} BTU 15% 2,806,300 BBL	3.23×10^{13} BTU 85% 5,300,780 BBL	5.42×10^{11} BTU 266,914 BBL	9.5%	6.54×10^{12} BTU 1,072,490 BBL	20%	1.36×10^{10} BTU 6707.05 BBL	.2%	2.05×10^{12} BTU 335,734 BBL	6%
329	1.04×10^{12} BTU 26% 511,245 BBL	2.95×10^{12} BTU 74% 485,027 BBL	2.44×10^{10} BTU 12,014.3 BBL	2%	9.75×10^{11} BTU 160059 BBL	33%	2.44×10^{10} BTU 12,014.3 BBL	2%	0 BTU 0 BBL	0
331	8.38×10^{10} BTU 9% 41230.8 BBL	8.47×10^{11} BTU 91% 138963 BBL	7.96×10^{9} BTU 3916.93 BBL	9.5%	6.99×10^{10} BTU 11,464.5 BBL	8%	5.45×10^{9} BTU 2680 BBL	1.9%	4.65×10^{10} BTU 7,642.98 BBL	5.5%
335	1.25×10^{12} BTU 11% 617060 BBL	1.01×10^{13} BTU 89% 1,664,190 BBL	5.69×10^{10} BTU 28014.5 BBL	4.5%	2.15×10^{12} BTU 352,809 BBL	21%	4.44×10^{10} BTU 21,843.9 BBL	3.5%	2.15×10^{12} BTU 352,809 BBL	21%
363	1.03×10^{11} BTU 9% 50486.7 BBL	1.04×10^{12} BTU 91% 170159 BBL	5.92×10^{9} BTU 2,914.85 BBL	5.8%	4.85×10^{11} BTU 79,646.3 BBL	47%	5.13×10^{9} BTU 2,524.34 BBL	5%	1.47×10^{11} BTU 24,106.4 BBL	14%

TABLE 16 (Cont'd.)

SIC Numbers	Present Consumption Electrical BTU % Use Barrels	Present Consumption Thermal BTU % Use Barrels	Electrical Am't.	%	Thermal Am't.	%	Electrical Am't.	%	Thermal Am't.	%
371	1.80×10^{12} BTU 19% 883,518 BBL	7.65×10^{12} BTU 81% 1,255,530 BBL	2.17×10^{11} BTU 106,561 BBL	12%	1.79×10^{12} BTU 294,151 BBL	23%	7.76×10^{10} BTU 38,168 BBL	4%	1.472×10^{12} BTU 241,469 BBL	19%
TOTALS	1.62×10^{14} BTU 26595761.61 BBL	4.97×10^{14} BTU 81,538,607.27 BBL	1.37×10^{13} BTU 2,251,416.87	8.4%	1.46×10^{14} BTU 23,976,106.55	29.4%	7.23×10^{12} BTU 1,186,499.41 BBL	4.46%	1.10×10^{14} BTU 18,030,047.45 BBL	22.1%